LDC	:	1 set
Power stations	:	5 sets
Mobile radios	:	4 sets
Spare	:	1 set

(c) Telecommunication mode

Duplex mode

(d) Function

Simple switching function is recommended for future data exchange.

3.3.5 Civil and Building Works

(1) General

(a)	Seismic load:	not considered
(b)	Maximum wind velocity:	25 m/s

(2) Foundation of the equipment

(a)	Bearing capacity of the ground:	30 tf/m^2
(b)	Safety factor of the foundations:	3.0
(c)	Design strength of concrete:	210 kgf/cm^2

(3) Site preparation

(a)	Embankment slope:	1:2.0
(b)	Rainfall intensity:	50 mm/hr

3.4 Basic Design

The rehabilitation and reconstruction plan for the power station, distribution lines, and telecommunications and load dispatching system under the Project are mentioned below. Figure II.3.4 shows power system diagram for the Project.

3.4.1 Utilization of the Existing Facilities

On the Project site, there are some facilities and machinery which were constructed and installed from November 1988 to September 1991. Since the construction was interrupted in 1991, the existing facilities and/or machinery were left on the site.

The existing buildings can be used again if works such as changing doors, windows and sashs, fittings, and metallic materials; painting of interiors and exteriors; and repair of roofs; are carried out. All of the installed existing machinery have been partly erected and remain in an incomplete condition and most have deteriorated or rusted, except for the 16-ton ceiling crane all other machinery cannot be used for the new power station. (Refer to Table II.3.6) Figure II.3.5 shows the layout of the No. 5 power station.

3.4.2 Generating Facilities

(1) General arrangement and layout

(a) Bus system

All of the existing systems are single busbar systems. This system is very simple and easy to operate. Therefore, the single busbar system will be adopted for the No. 5 power station. (Refer to Single Line Diagram, Fig. II.3.6)

(b) Connection method for the main unit

The low voltage synchronized connection method was used for most of the existing main units; not the unit connection method. Therefore, the low voltage synchronizing connection method will be adopted for the No. 5 power station.

(c) Grounding system

The existing neutral terminal of the 15 kV side of the main transformer is a non-grounding system. The existing 15 kV distribution line also uses the non-grounding system. Therefore, the non-grounding system will be applied to the neutral terminal of the main transformer. The existing neutral terminal of the 6,000 kW generator at the No. 2 power station uses a resistor grounding system with high impedance. Therefore, the neutral resistor grounding system will be adopted for the neutral terminal of the diesel engine generator for the No. 5 power station.

(d) Station service circuit arrangement

All the existing station circuits are dual systems for easy maintenance. The dual circuit system will be adopted for the No. 5 power station for easy operation and maintenance.

(e) Layout and equipment arrangement

The site for the No. 5 power station has not been levelled. Land formation as well as additional structures are required for the new plant. Figure II.3.7 shows the new layout for the No. 5 power station. In the existing power house, foundations for diesel engine generators were constructed. The erection bay is located on the opposite side of the entrance of the No. 5 power station area. Therefore, the new diesel engine generators will be installed at the back of the erection bay for easy extension of future machines.

(f) Control system

The existing control system is a manual control system. This system is simple and easy for operation and maintenance. The same system will be adopted for the No. 5 power station, i.e. a one-man control system is applied.

In the Basic Design, the main specifications for the major generating facilities will be as follows:

(2) Diesel engine

(a)	Type	:	Vee-type, 4 stroke cycle, water cooled, trunk piston type supercharged medium speed diesel engine with air cooler
(b)	Rated output	:	More than 7,050 PS (Generator rated output 5,000 kW)
(c)	No. of units	:	2
(d)	Engine output	:	7,050 PS or more
(e)	Rated speed	:	Less than 750 rpm
(f)	Overload	:	110% 1 hour

(g)	Fuel system	:	Automatic feeding system with 1,000 kl storage tank. The storage tank shall be newly constructed (refer to Fig. II.3.8)
(h)	Lubricating oil system	:	Manual feed system with 5 kl sump tank (refer to Fig. II.3.9)
(i)	Cooling system	:	By means of cooling tower with treatment facilities including pump station at the Tonle Sap river side (refer to Fig. II.3.10 and 11)
(j)	Starting system	:	By means of compressed air
(k)	Intake exhaust air system	:	Filter and silencer type
(l)	Fuel system	:	Diesel oil equivalent to JIS K 2204-2
(m)	Governor	:	Electric type and/or hydraulic type

(3) Generator

(a)	Type	:	Cylindrical, rotating field, 3 phase, synchronous, air cooled AC generator
(b)	Electric system	:	3 phase, 3 wire system
(c)	Rated capacity	:	6,250 kVA (rated output 5,000 kW) per unit
(d)	No. of units	:	2
(e)	Rated voltage	:	6.3 kV
(f)	Frequency	:	50 Hz
(g)	No. of poles	:	More than 8
(h)	Power factor	:	0.8
(i)	Exciter type	:	Brushless, rotating type with automatic voltage regulator
(j)	Exciter cooling	:	Self-ventilated, air cooled type

The engine, generator, and auxiliaries shall be assumed to operate continuously under the following conditions.

(a)	Ambient temperature	:	min. 13°C, max. 40.5°C
(b)	Engine room temperature	:	Design 40°C
(c)	Raw water temperature	:	27°C - 32°C
(d)	Elevation	:	Less than 100 m MSL
(e)	Place of installation	:	Indoor

(4) Main transformer

(a)	Type	:	3 phase, oil immersed, outdoor type with on load tap changer
(b)	Voltage ratio	:	6.3 kV / 15 kV
(c)	Rated capacity	:	6,300 kVA
(d)	Cooling system	:	ONAN
(e)	No. of units	:	2

(5) 15 kV switchgear

(a)	Type	:	Indoor, metal-clad switchgear
(b)	Rated voltage	:	17.5 kV
(c)	Circuit breaker	:	Vacuum type
(d)	No. of circuits	:	6 feeders

(6) 6.6 kV switchgear

(a)	Type	:	Indoor, metal-clad switchgear
(b)	Rated voltage	:	7.2 kV
(c)	Circuit breaker	:	Vacuum type for generator power fuse for station service circuit

(7) Low voltage switchgear

(a)	Type	:	Indoor, metal-clad switchgear
(b)	Rated voltage	:	600V
(c)	Circuit breaker	:	Air break type for main circuit

(8) DC supply

(a)	Method	:	Alkali battery and charger
(b)	Rated voltage	:	DC 110V
(c)	Battery capacity	:	100 AH

(9) Station service transformer

(a)	Type	:	3 phase, oil immersed, outdoor type with no voltage tap changer
(b)	Voltage ratio	:	6.3 kV / 400-230V
(c)	Rated capacity	:	630 kVA

(d) Cooling system : ONAN
(e) No. of units : 2 sets

(10) Control and protection equipment

(a) Control mode : One-man control
(b) Protection mode : By static relays, auto. off/indication/alarm
(c) Equipment : Static type

3.4.3 Distribution Line Facilities

The location of distribution line facilities and a route map of the distribution lines to be constructed under the Project is shown in Figure II.3.14. Major features of the distribution line facilities are as follows:

(1) Overhead distribution line materials

(a) Overhead line support

Supports for overhead lines are to be of a jointable steel tubular type, with length of pole being 13.7 m. On the top of the poles, the overhead ground wire is to be supported. Stay wire is set with drive type steel anchors to increase the strength of angle type and dead-end type supports. The pole assembly of the 15 kV distribution lines is shown in Figures II.3.15, II.3.16, and II.3.17.

The height of poles was decided as follows:

(i)	Minimum height of conductor above ground	7.0 m
(ii)	Maximum sag of conductor	1.67 m (Span: 50 m)
(iii)	Distance from lower crossarm to the top of pole	2.7 m
(iv)	Clearance	0.03 m
(v)	Depth of pole	2.30 m
	Total	13.70 m

(b) Insulators

Pin and disk insulators are to be used for supporting the 15 kV line conductors. The conductors will be fixed to the insulators by bare annealed aluminium bind wires.

(c) Conductors

To reduce the weight of conductors, hard drawn aluminium (HAL) conductors will be used instead of the existing bare ACSR conductors.

The size of conductors is decided as follows:

As discussed in Part 1 "Master Plan Study", the total possible output of the power generating plants in Phnom Penh including the output from the Project and other foreign assistance will be about 85 MW in 1995. This output should meet with the demand in Phnom Penh in 2000. At present, the unit capacity of the No. 2 and No. 3 power stations are 4,200 kW and 6,000 kW, respectively. Therefore, the capacity of the interconnection line should be 10,000 kW in order to to distribute power between the northern and southern system and to supply power in case of failure of one of the units in the power system.

The maximum current flowing in the interconnection lines is computed as follows:

$$I = 10,000/1,732/20/0.85 = 340 \text{ (A)}$$

Allowable maximum currents of conductors are as follows:

HAL 95 sq.mm ..... 320 (A) < 340 (A)
HAL 120 sq.mm ..... 400 (A) > 340 (A)

Consequently, HAL 120 sq.mm will be used for the interconnection line.

(d) Overhead ground wire

For protection against lightning, an overhead ground wire will be fixed on the top of the pole. The wire will be 45 sq.mm galvanized steel stranded wire.

(e) Cross arms

The conductors on the 15 kV lines will be arranged in vertical formation for two circuits on the cross arms and will have a 2.0 m-long cross arm which is to be fixed to the pole with a through bolt and arm tie.

(f) Lightning arresters

Lightning arresters will be of 21.0 kV, 5 kA, and are mounted on the end of lines and at the joint of underground cables and overhead lines.

(g) Grounding

The lightning arrester, switch case, transformer tank, secondary neutral of transformer and other metal parts required for safe operation will be grounded by means of a grounding rod.

Copper coated steel rods will be used for grounding.

(2) Underground cable line materials

20 kV cables, consisting of 150 and 100 sq.mm x 3-cores copper conductors, vinyl sheathed, cross linked polyethylene insulated steel armored type, will be used.

The cable head ends will be of premould stress cone type and the straight through joint of the cables will be installed in concrete pits for their protection. The cable laying drawing is shown in Figure II.3.19.

Cable size is decided as follows:

(a) Interconnection cables between the No. 5 power station and No. 3/No. 2 power station

As computed above, the maximum load current is 340(A). To meet this current, the cable size was decided as follows:

3 core 150 sq.mm XLPE ..... 350 (A) > 340 (A)

(b) City distribution cables

The maximum load on one feeder is assumed to be 5,000 kVA. From this load, the load current was calculated as 320(A). Considering the operation and maintenance of the line, it is recommended that the cable size be the same. Therefore, 3 core 150 sq.mm XLPE is to be used for the city distribution cable line.

(c) Interconnection cable between the No. 5 power station and No. 4 power station

Output of the No. 5 power station is 10 MW (5,000 kW x 2 sets). For the reasons stated above, 3-core 150 sq.mm XLPE will be used for the interconnection cable line between the No. 5 power station and No.4 power station.

(d) Interconnection cable between the No. 5 power station and No. 1 power station

For the same reasons stated above, 3-core 150 sq.mm XLPE will be used for the interconnection line between the No. 5 power station and No. 1 power station.

(3) Distribution transformers

Distribution transformers will be outdoor 3-phase oil immersed type with a voltage ratio of 15 kV/380-220 V. All the distribution transformers will be 250 kVA capacity.

(4) Distribution switchgear

Distribution switchgear which is to be mounted in a cubicle, will be of indoor use, self-standing, metal-clad type. The new cubicles are to be installed at the existing substations and distribution stations as follows:

(i)	No. 1 power station	:	outdoor, metal-clad, 15 kV, with CB
(ii)	No. 2 power station	:	outdoor, metal-clad, 15 kV, with CB
(iii)	No. 3 power station	:	outdoor, metal-clad, 15 kV, with CB
(iv)	No. 4 power station	:	outdoor, metal-clad, 15 kV, with CB
(v)	No. 8 substation	:	indoor, metal-clad, 15 kV, with DS
(vi)	No. 7 substation	:	indoor, metal-clad, 15 kV, with DS & PF
(vii)	No. 127 distribution station	:	indoor, metal-clad, 15 kV, with CB/DS/PF
(viii)	No. 20 distribution station	:	indoor, metal-clad, 15 kV, with LBS
(ix)	New distribution station	:	outdoor, metal-clad, 15 kV, with DS & PF

Note: CB: Circuit breaker, DS: Disconnecting switch, PF: Power fuse, LBS: Load break switch

A connection diagram of the substations and distribution stations is shown in Figure II.3.20.

3.4.4 Telecommunications and Load Dispatching System

The system diagram of telecommunications and load dispatching system is shown in Figure II.3.21. The major features of the system are as follows:

(1) Fixed radio station facilities (LDC, each power station)

(a) Frequency band	:	335-470 MHz
(b) Channel capacity	:	8 channels or more
(c) Modulation method	:	PM
(d) RF output	:	25 W (tentative)
(e) Receiving method	:	Synthesizer method
(f) Noise level	:	6.5 dB or less
(g) Input impedance	:	Approx. 600 ohms unbalanced
(h) Receiving sensitivity	:	0.5 μV or less (12 dB SINAD)

(2) Mobile radio facilities (car mounted type)

(a) Frequency band	:	335 - 470 MHz
(b) Channel capacity	:	8 channel or more
(c) Modulation method	:	PM
(d) RF output	:	5 W

(3) Antenna

(a) Frequency band	:	400 MHz band
(b) Type/gain	:	Collinear type/14 dBi (LDC, each power station)
(c) Impedance	:	50 ohms average

(4) Collective supervisory board (Refer to Fig. II.3.22)

(a) Construction	:	Self-standing, metal enclosed cubicle type
(b) Indication mode	:	Manual lamp indication and figures indication (MW, down to one decimal place)
(c) Color symbol mark	:	15 kV (white), 6 kV (yellow), 4 kV (blue)

(5) Power supply equipment

(a) Type	:	Compact battery/charger set (LDC, each power station)
(b) Voltage	:	DC 24V or 12V
(c) Capacity	:	5 hours or more

3.4.5 Civil and Building Works

(1) Outdoor works

The required civil works are as follows:

(a) Completion of site preparation
(b) Drainage work
(c) Pavement work
(d) Foundation works for facilities for D/G

The basic concept for design of civil works is as follows:

(a) Completion of site preparation

The No. 5 power station is build on reclaimed ground as mentioned above. On the site, gully erosion by rain is now becoming serious because some earthworks and slope protection have not been completed. It is necessary to complete the site preparation work as shown in Figure II.3.23. Figure II.3.24 shows the cut and fill areas. The volume of earthworks is as follows:

Cut:	1,000 m
Fill:	3,300 m
Balance:	2,300 m

The water level of the lake surrounding the embankment rises to the middle of the slope in rainy seasons. The slope is covered by cast-in concrete, which is considered to be the most reliable method of slope protection against erosion by water from the lake as shown in Figure II.3.25. The specifications for slope protection are as follows:

Thickness of the concrete:	150 mm
Steel bar:	D6,200 mm mesh

For security reasons a fence should be installed around the site and a gate provided at the entrance.

(b) Drainage work

The area of the site was divided into three zones as shown in Figure II.3.26 to calculate the quantity of discharge for each zone. There are three surface types on the site, i.e., pavement, lawn, and building. The standard runoff coefficient of each surface is shown below:

Surface	Runoff coefficient
Pavement	0.85
Lawn	0.2
Building	0.9

The catchment area of each zone is shown below.

Zone	Pavement	Lawn	Building	Total
1	0	3,000	0	3,000
2	1,800	4,900	900	7,600
3	1,200	6400	1,800	9,400
Total	3,000	14,300	2,700	20,000 m^3

The mean runoff coefficient of each zone was obtained as shown below by calculating the weighted average.

Zone	Mean runoff coefficient
1	0.2
2	0.44
3	0.42

The design peak discharge was calculated by using the rational formula shown below:

$$Q = \frac{1}{360} CIA$$

where; Q: design peak discharge (m^3/s)
C: runoff coefficient
I: rainfall intensity (mm/hr)
A: catchment area (ha)

Zone	C	I	A	Q
1	0.2	50	0.30	0.008
2	0.44	50	0.76	0.046
3	0.42	50	0.94	0.055

Assuming that the cross-section of the ditch is 300 x 300 mm and the slope of channel bed is 0.5%, the quantity of discharge was calculated by the following equation:

$$Q = vA = 0.092 \text{ m}^3/\text{s}$$
$$v = \frac{1}{n} R^{2/3} I^{1/2} = 1.02 \text{ m/s}$$

where; Q: discharge (m^3/s)
v: mean velocity (m/s)
A: flow area (m^2)
n: coefficient of roughness (= 0.015)
R: hydraulic radius (m)
I: slope of channel bed

Comparing with the design discharge, it can be concluded that the assumed ditch is large enough. Thus the cross-section of the ditch on the site was deemed to be 300 mm x 300 mm.

Using the same method, the cross-section of the ditch under the slope that will drain water from the site to the lake was deemed to be 900 mm x 300 mm.

(c) Pavement work

Pavement works for the access road, storage yard, and footpaths are planned. The thickness of each pavement was determined with reference to "The Guideline for Asphalt Pavement" and "The Guideline for Concrete Pavement" that are published by the Japan Roads Association.

(i) Access road

Lorry traffic is expected on the site for the No. 5 power station for maintenance and/or installation of new equipment in the future. The surface of the ground weakens and the trafficability gets worse in the rainy season because the site is reclaimed ground filled by clayey soil. Therefore for the above reasons, pavement work is necessary for the access road.

Cooling water pipes, fuel pipes and cables are planned to be laid under the access road. Asphalt pavement is considered the most suitable for the access road, considering the maintenance of underground pipes and cables in the future. The width of the road is basically 6 meters. The width of the road in front of the entrance of the powerhouse is 10 meters. California Bearing Ratio (CBR) of the ground is assumed to be 4 because the water content of the soil increases and the ground weakens in the rainy seasons. The structure of the pavement is as follows:

Asphalt:	5 cm
Upper subbase:	15 cm
Lower subbase:	15 cm
Total:	35 cm

Figure II.3.25 shows the pavement structure.

(ii) Storage yard

The storage yard is planned for heavy and/or large spare parts for diesel engines and/or for construction materials for distribution lines. Concrete pavement is suitable for the storage yard. CBR is assumed to be 4 and the structure of the pavement is as follows:

Concrete slab:	15 cm
Subbase:	25 cm
Total:	40 cm

Figure II.3.25 shows the pavement structure.

(iii) Footpath

Footpath paved with concrete blocks is planned to be installed around the control house, oil tanks, precipitator, and cooling towers.

(d) Foundations of outdoor facilities

Figure II.3.27(1) and Figure II.3.27(2) show the foundations of outdoor facilities. Concrete slabs placed on lean concrete blocks on the original foundation layer, that is 2.5 meters deep from the surface of the ground, are used for foundations for heavy facilities such as transformers. Other facilities have spread foundations. Characteristics of the facilities to be installed are as follows:

(i) Transformer

Type:	6,300 kVA / 630 kVA
Vertical load:	19 tons/2.5 tons
Quantity:	each one
Foundation type:	concrete slab

(ii) Oil storage tank

Type:	diameter 14 m, height 6.5 m, capacity 1,000 m^3
Vertical load:	2,000 tons
Quantity:	two sets
Foundation type:	concrete slab

(iii) D/O buffer tank

Type:	capacity 5 m^3
Vertical load:	9 tons
Quantity:	one
Foundation type:	concrete slab

(iv) Oil fence

Type:	concrete wall
Vertical load:	0 ton
Quantity:	total length 162 m
Foundation type:	spread foundations

(v) Silencer

Type:	filter and silencer
Vertical load:	11 tons
Quantity:	two
Foundation type:	concrete slab

(vi) Cooling tower

Type:	concrete structure
Vertical load:	5 tons
Quantity:	one
Foundation type:	concrete slab

(vii) Precipitator

Type:	concrete structure
Vertical load:	0 ton
Quantity:	one
Foundation type:	spread foundations

(viii) Dosing device

Type:	concrete structure
Vertical load:	5 tons
Quantity:	four
Foundation type:	spread foundations

(ix) City water tank

Type:	concrete structure
Vertical load:	0 ton
Quantity:	one
Foundation type:	spread foundations

(2) Repair work of powerhouse

Although the present condition of the No. 5 powerhouse is still good, some repair work on the foundations for the diesel engines and other equipment, lights, air-conditioners, interior and exterior and other facilities of the building are necessary.

(a) Foundations for diesel engines

The existing foundations for the diesel engines are spread foundations. The dimensions of the concrete base blocks are 11 meters long, 4 meters wide, and 2.5 meters deep. Assuming the weight of diesel engine is 60 tons, the vertical pressure is as follows:

$$p = (60 + 11 \times 4 \times 2.5 \times 2.3) / (11 \times 4)$$
$$= 7.1 \text{ tf/m}^2 < \text{bearing capacity} = 10 \text{ tf/m}^2$$

The strength of the concrete base blocks was assumed to be at least 210 kgf/cm^2 based on the results of the non-destructive tests carried out by the Study Team. Thus, it can be concluded that the existing concrete base blocks can be used for new machines if some repair work on the surfaces is done after the surface of the existing foundations is cut. Figure II.3.28 shows the detailed repair work of the foundations.

(b) Foundations of other facilities

Foundations for auxiliary blocks, oil treatment unit, sludge treatment unit, and control unit are necessary. Figure II.3.29 shows the foundations.

(c) Wall

The wall of the powerhouse in front of diesel engines will be damaged when the existing machines are removed and will need to be repaired after new machines are installed.

(d) Interior and exterior finish

Painting work for the interior and exterior of the powerhouse is planned.

(e) Lighting apparatus

Table II.3.7 shows lighting apparatus required in the power station.

(f) Air-conditioners

The design temperatures and the required capacity of air conditioners in each area in the powerhouse are as follows:

- HV switchgear room:

design temperature:	35°C
calorific value of machines:	6,000 kcal/hr
others:	220 m^2 x 200 kcal = 44,000 kcal/hr
Total:	50,000 kcal/hr

Required air conditioners (example): 18,500 kcal/hr/unit x 3 units

- Control room:

design temperature:	25°C
calorific value of machines:	3,000 kcal/hr
others:	140 m^2 x 200 kcal =28,000 kcal/hr
Total:	31,000 kcal/hr

Required air-conditioners (example): 18,500 kcal/hr/unit x 2 units

- HV switchgear room:

design temperature:	25°C
others:	60 m^2 x 200 kcal = 412,000 kcal/hr
Total:	50,000 kcal/hr

Required air-conditioners (example): 4,000 kcal/hr/unit x 3 units

(g) Emergency devices

Fire-fighting devices and sign boards that show dangerous zones and evacuation routes are planned to be installed in the powerhouse.

(h) Ventilator house

A ventilator house is necessary for cooling of new diesel engines. The area of the house is 37.5 m^2.

3.5 Construction Plan

3.5.1 Construction Works

The implementing Agency on the Cambodian side for the Project is EDP. At present, EDP has no construction plans. EDP intends to establish a construction plan before

implementation of the Project. However, following are the recommendable policy of the construction works.

(1) Generating facilities

Proper management of construction works for the generation facilities is most important. Management consists of three elements: quality control, staff control, and budget control. Quality control is conducted on both the manufacturing and erection work, and staff control is carried out on the work site mainly. Budget control is monitored according to the construction time schedule and progress payments.

Safe construction of the generating facilities should be assured if the above-mentioned control system is enforced.

(2) Distribution line facilities

The same considerations as mentioned above (1) also apply to construction works for the distribution line facilities. To maintain high reliability of the system operation, the following essential points were considered:

(a) Underground cable lines are to be constructed in accordance with the specific actions of the cable.

(b) Shorter power shutdowns and safety measures are demanded from the reconstruction works of 15 kV cubicles at the respective substations and distribution stations.

Reliable local contractors for the construction of the power distribution system are in short supply in Cambodia; daily maintenance, repair, and construction works are done by EDP. All construction works under the Project will be executed by local contractors and EDP's staff under the guidance of the Japanese Contractor(s), except for special works, such as commissioning tests, jointing cables, terminating cable heads, and other key works, which will be done by Japanese specialists.

(3) Telecommunications and load dispatching system facilities

The same considerations as mentioned above (1) and (2) also apply to construction works for the telecommunications and load dispatching system

facilities. In addition, enhancement of telecommunications system quality and training of personnel was considered for future system expansion.

(4) Works undertaken by the Consultant

EDP is not capable of implementing the Project. Therefore, planning, designing, and supervising the Project works will be undertaken by the Japanese Consultant.

The works to be undertaken by the Consultant, Contractor, and EDP are mentioned below:

(a) Works to be undertaken by the Consultant

(i) Home works

- To prepare the detailed design of the power station, substations, distribution stations, underground cable lines, overhead distribution lines, and telecommunications and load dispatching system.
- To prepare the tender documents for procurement and erection of materials and equipment.
- To execute tendering work and evaluation.
- To approve and comment on the design, specifications and drawings provided by the Contractor(s).
- To attend the pre-shipment inspection and test on the materials and equipment at the manufacturer's factories.
- To prepare inspection certificates.
- To report and explain to JICA.

(ii) Site works

- To prepare the working drawings for civil and building works for the power station, etc.
- To coordinate and inspect the wave propagation test.
- To adjust and check the construction schedule.
- To prepare route map and assembly drawings for distribution lines.
- To assist EDP in construction supervision.

- To approve the commissioning tests schedule submitted by the Contractor(s).
- To attend the commissioning tests.
- To transfer technical knowledge.
- To prepare the monthly reports on construction.
- To prepare progress payment certificates.
- To prepare the completion report for the Project.

(b) Works to be undertaken by the Contractor

The works to be undertaken by the Contractor include designing, manufacturing, testing, painting, packing, transportation, and erection of the materials and equipment to be supplied under the Project.

As discussed with EDP, obtaining the necessary permission from the concerned authorities for execution of the Project and dismantling and reconnecting of service wires to the consumers' will be undertaken by the Cambodian side.

As explained in Section 3.1.2, in order to obtain permission from the Road Department, the Contractor is required to submit applications with work plans to excavate roads prior to the commencement of excavation and restoration of public roads as required under the Project.

(c) Works to be undertaken by EDP

- To make banking arrangements.
- To assist in customs clearance of equipment and materials in Cambodia.
- To obtain necessary permits for imports into Cambodia and to bear the license fee.
- To get permission from other authorities concerned for the construction works when needed.
- To coordinate with the residents in the Project area on matters that may arise during the implementation of the Project.
- To obtain permission for frequency allocation.

- To get permission to use water from the Tonle Sap river.
- To make the necessary arrangements for power shutdown according to the construction schedule.
- To provide a stockyard for imported materials and equipment.
- To secure a stockyard for materials and equipment to be granted.
- To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.

3.5.2 Conditions on the Site Construction Works

The matters to be attended to for the site construction works are described below:

(1) Special consideration for construction work is to be taken so as to avoid overlapping the construction works by heavy equipment.

(2) Special consideration for installation and testing of electrical equipment is to be taken to ensure safety.

(3) Though acquisition of private and arable lands for the Project is easy, the lands are swampy. Therefore, new lines will be constructed along the road or on the existing line routes.

(4) Power shall be shutdown during the execution of construction and reinforcement works for distribution lines and reconnection of cables to power stations. Power supply shall resumed toward evening. Special attention shall be paid to the work schedule and pre-information to the customers for the shutdowns.

(5) For construction of underground cables, prior applications will be required in order to get the necessary permission from the Road Department. The finishing works, including paving and asphalting of roads, will be done by the Contractor according to the regulation of the Road Department.

(6) For tree felling and trimming for distribution line works including exploration of the line route, prior applications for permission from the concerned authorities are required.

3.5.3 Construction Supervision Plan

EDP normally forms an individual project team for execution of projects to be implemented under the financial assistance of foreign countries. The Study includes the

Master Plan and Basic Design Study of the Project and execution of this Project will be carried out soon.

EDP's project office will administrate and coordinate the Project works. The design and construction supervision of the Project will be undertaken by the Consultant. The works to be done by EDP, such as supervision of construction work and storage of the dismantled materials and equipment, will also be managed by the project office. Besides, the project office has responsibility to coordinate with MOI/MPP for the works mentioned in Section 3.5.1 (4)(c) "Works to be Undertaken by EDP".

3.5.4 Procurement Plan of Materials and Equipment

Supply and erection of materials and equipment for the Project will be executed by Japanese Contractor(s). However, considering local material prices, materials such as gravel, plywood and bricks will be procured in Cambodia. Major equipment and materials to be provided are shown in Table II.3.8.

3.5.5 Transportation Plan

All materials and equipment procured in Japan will be transported from Japan to Phnom Penh by the following route:

Japan - transport by sea - Cambodia (Kompong Som) - transport by land (Route 4) or railway - Phnom Penh

From the economical aspect, equipment and materials are to be packed and transported by container, except heavy machines:

- Heavy machines and equipment transportation (Diesel engines, generators, transformers, etc.) : railway Max. 40 tons
- Other equipment : truck Max. 30 tons

The customs procedures for the materials and equipment will be carried out at Kompong Som Port.

3.5.6 Implementation Schedule

The Project will be implemented in two stages and the sub-projects for each stage are divided as follows:

Stage-1 Project

(1) Generating facilities

(a) Diesel engine generator set, 5,000 kW x 1 set
(b) Auxiliary equipment
(c) Transformer, 6,300 kVA x 1 set
(d) 6.3 kV switchboard
(e) 15 kV switchboard, in total 4 sets
for city service : 2 sets
for No. 1 P/S : 1 set
for No. 4 P/S : 1 set
(f) Station service transformer, 630 kVA x 1 set
(g) AC panel, Motor Control Center
(h) Battery and charger 1 set
(i) Control and protection equipment

(2) Distribution line facilities

(a) City service distribution line, 2 circuits 7.6 km
(b) Interconnection line for No. 1 P/S and No. 4 P/S
(c) Substation transformer, 250 kVA x 3 sets
(d) Distribution switchgear, single bus bar with CB for No. 1 P/S and No. 4 P/S
(e) Distribution switchgear, single bus bar with LBS, 5 sets (S/S No. 8, No. 127, No. 20)

(3) Civil and building works

(a) Civil construction work (land formation, access road, drain ditch, outdoor civil work)
(b) Building work (generator and auxiliary equipment foundations, painting, lighting, air-conditioning)

Stage-2 Project

(1) Generating facilities

(a) Diesel engine generator set, 5,000 kW x 1 set
(b) Transformer, 6,300 kVA x 1 set
(c) 6.3 kV switchboard
(d) 15 kV switchboard, in total 2 sets

Interconnection lines: 2 sets

(e) Station service transformer, 630 kVA x 1 set

(f) Motor Control Center

(g) Control and protection equipment

(2) Telecommunications and load dispatching system

(a) Fixed station equipment, 6 sets (LDC 1 set, power stations 5 sets)

(b) Mobile equipment, 4 sets

(c) Collective supervisory board

(d) Power supply equipment

(3) Distribution line facilities

(a) North-South interconnection line, 22.0 km

(b) Distribution switchgear, single bus bar with CB for No. 3 P/S, 4 sets

(c) Distribution switchgear, double bus bar with CB for No. 2 P/S, 2 sets

(d) Distribution switchgear, single bus bar with LBS, 2 sets (S/S No. 7, No. 193)

3.5.7 Scope of Work

This Project is to be implemented through close cooperation between the Government of Japan and the Government of Cambodia within the framework of grant aid from the Government of Japan. It is reasonable for the Governments of the two countries to share the Project between them as follows:

(1) The work to be done by the Government of Japan

(a) Supply and erection of the generating facilities of 10 MW capacity at the No. 5 power station including the auxiliary equipment described in Section 3.4.2.

(b) Supply and installation of the facilities for 15 kV underground cables and overhead distribution lines including distribution transformers and switchgear described in Section 3.4.3.

(c) Supply and erection of the telecommunications and load dispatching system facilities described in Section 3.4.4.

(d) Supply of maintenance tools, instruments, and spare parts sufficient for two years of operation.

(e) Other related works to the above such as transportation of facilities and equipment, civil and building works (Refer to Section 3.4.5), and on-the-job training (Refer to Sections 2.3.4(3) and 2.4).

(2) The work to be done by the Government of Cambodia

(a) Site structure

- To secure the right-of-way for the Project.
- To construct access roads to the sites when needed.

(b) Infrastructures

- To provide the facilities for city water distribution to the site when needed.

(c) Procedural work and expenses to be borne by the Cambodian side

- To assist in clearance of the equipment and materials in Cambodia.
- To obtain the necessary import permits into Cambodia and bear the license fee of such permits.
- To get permission from other authorities concerned when needed.
- To bear banking arrangement expenses.
- To bear all the expenses, other than those to be borne by the Grant necessary for construction of the facilities, as well as for the transportation and installation of the equipment.
- To exempt Japanese nationals from custom duties, internal taxes, and other fiscal levies which may be imposed in Cambodia with respect to the supply of the products and services for the Project.
- To accord Japanese nationals, whose services may be required in connection with the supply of products and services for the Project with such facilities that may be necessary for their entry into Cambodia and stay therein for the performance of their work.
- To coordinate with the residents in the Project areas on matters which may arise during the implementation of the Project.
- To make necessary power shutdowns according to the construction schedule.

- To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.

It is desirable that GOC provide a budget for the Project and conduct the works on schedule so that the entire Project will be implemented smoothly and the facilities to be constructed under the Project are utilized effectively.

Table II.3.1 Temperature, Humidity, and Rainfall in Phnom Penh

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average	Record Period
Temperature (℃)	Max.	36.3	36.7	39.0	40.5	39.7	38.4	36.6	36.0	35.1	34.4	34.4	34.8	36.8	53 years
	Min.	13.3	15.2	16.5	17.9	20.6	21.2	20.1	21.5	21.6	20.8	16.8	14.4	18.3	53 years
	Average	25.8	27.4	28.9	29.7	28.8	28.6	27.6	27.5	27.1	27.0	26.5	25.3	27.5	39 years
Humidity (%)		69.5	67.9	65.9	69.9	77.3	76.8	80.2	80.2	83.9	84.6	79.0	73.5	75.7	37 years
Rainfall (mm)	Days	0.6	1.0	1.1	7.3	15.0	17.9	20.2	20.5	22.5	21.3	11.7	1.5	11.7	12 years
	Q'ty	5.6	6.1	21.6	63.2	135.7	125.8	142.0	150.3	246.1	234.9	124.2	31.5	107.3	40 years

Table II.3.2 Maximum Wind Velocity & Direction in Phnom Penh (Dept. of Meteorology, MOA)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.	Max.
1981	8.0	8.0	8.0	8.0	8.0	10.0	12.0	18.0	10.0	8.0	12.0	8.0	9.8	18.0
	N	SE, SSE	S, SE	S, SE	S,SE,SSW	SW	W	W	W	WNW	S	N		
1982	8.0	6.0	8.0	6.0	6.0	8.0	12.0	12.0	12.0	12.0	16.0	12.0	9.8	16.0
	NNE	S	E	N	S	W	W	WNW	W	SSW	E	N		
1983	12.0	12.0	8.0	12.0	16.0	12.0	16.0	16.0	14.0	16.0	12.0	8.0	12.8	16.0
	N	S	E	S	S	W	SSE	NW	E	NE	E	NE		
1984	8.0	6.0	12.0	14.0	10.0	12.0	12.0	12.0	10.0	12.0	8.0	8.0	10.3	14.0
	NE	W	S	S	W	W	S	W	NW	E	NE	N		
1985	8.0	16.0	12.0	16.0	12.0	18.0	20.0	12.0	14.0	8.0	12.0	6.0	12.8	20.0
	NE	SE	S	W	S,W	W	W	W	NW	N	NNW	N		
1986	8.0	6.0	10.0	8.0	14.0	12.0	10.0	8.0	10.0	8.0	8.0	6.0	9.0	14.0
	N	E	SE	E	S	W	NW	W	SW	N	NNE	N		
1987	6.0	6.0	8.0	16.0	16.0	14.0	16.0	12.0	6.0	6.0	8.0	6.0	10.0	16.0
	N	N	S	S	E	SW	W	NW	N	SE	S	N		
1988	6.0	6.0	6.0	10.0	8.0	16.0	16.0	12.0	12.0	12.0	10.0	8.0	10.2	16.0
	N	SE	E	SE	S	SE	W	SW	SW	W	N	NNE		
1989	6.0	6.0	14.0	12.0	18.0	16.0	15.0	16.0	14.0	12.0	9.0	10.0	12.3	18.0
	N	S	E	N	W	W	SSW	W	SW	S	NE	N		
1990	4.0	7.0	8.0	10.0	12.0	10.0	14.0	7.0	6.0	12.0	6.0	6.0	8.5	14.0
	SW	E	NE	S	S	S	W	WSW	WSW, SW	E	NW,N,NNW	NNE		
1991	4.0	6.0	6.0	8.0	10.0	10.0	8.0	8.0	8.0	14.0	6.0	6.0	7.8	14.0
	NNE,ENE	NNE,S	SE,S	NNE	SE	W	W	W	W,WSW	NW	N	N		
Ave.	3.7	4.0	4.8	5.7	6.2	6.6	7.2	6.3	5.5	5.7	5.1	4.0	10.3	
Max.	12.0	16.0	14.0	16.0	18.0	18.0	20.0	18.0	14.0	16.0	16.0	12.0		20.0

Table II.3.3 Number of Thunders in Phnom Penh (Dept. of Meteorology, MOA)

Year		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1981	N	-	-	-	4	2	1	2	-	-	-	-	-	9
	F	-	-	-	8	25	12	22	19	25	8	13	-	132
1982	N	-	-	-	2	-	1	2	-	-	2	3	-	10
	F	-	-	4	13	13	10	2	-	8	16	13	-	79
1983	N	-	-	-	-	1	-	-	-	-	-	-	-	1
	F	-	-	-	-	10	12	14	12	12	10	10	-	80
1984	N	-	-	3	-	-	-	-	-	-	-	-	-	3
	F	-	2	11	11	17	8	11	4	9	20	1	-	94
1985	N	-	-	-	-	-	-	-	-	-	-	-	-	0
	F	-	-	3	15	13	6	12	7	23	18	14	-	111
1986	N	-	-	-	-	-	-	-	-	-	-	-	-	0
	F	-	-	2	5	18	15	16	11	16	21	1	4	109
1987	N	-	-	-	-	-	-	-	-	-	-	-	-	0
	F	-	-	-	4	14	11	14	18	12	16	15	-	104
1988	N	-	-	-	-	-	-	-	-	-	-	1	-	1
	F	-	1	1	12	9	11	12	14	17	7	-	-	84
1989	N	-	-	-	2	8	4	3	5	9	3	4	-	38
	F	-	-	5	2	8	9	12	5	14	8	2	-	65
1990	N	-	-	1	1	2	3	1	3	8	-	1	-	20
	F	-	-	1	4	9	4	13	6	4	4	3	-	48
1991	N	-	-	-	-	1	1	1	1	5	11	-	-	20
	F	-	-	1	4	13	13	11	9	12	3	-	-	66

Table-II.3.4 Result of Water Quality Test

Item	Unit	Amount
pH		7.7
Colour	degree	45
Turbidity	degree	25
Total Alkalinity	*mg/l*	31.1
Chloride	*mg/l*	3.2
Sulfate	*mg/l*	1.1
NO_3-N	*mg/l*	0.07
NO_2-N	*mg/l*	0.04
NO_4-N	*mg/l*	0.28
Total Nitrogen	*mg/l*	0.66
PO_4-P, Phosphate-Phosphorus	*mg/l*	ND (less than 0.01)
Total Phosphorus	*mg/l*	0.06
Potassium permanganate consumption	*mg/l*	16.1
COD	*mg/l*	6.2
BOD	*mg/l*	1.8
Iron	*mg/l*	0.75
Manganese	*mg/l*	0.06
Calcium	*mg/l*	8.0
Magnesium	*mg/l*	2.7
Total hardness	*mg/l*	31.0
Silica	*mg/l*	5.7
Copper	*mg/l*	ND (less than 0.01)
Lead	*mg/l*	ND (less than 0.01)
Zinc	*mg/l*	0.01
Cadmium	*mg/l*	ND (less than 0.005)
Total Mercury	*mg/l*	ND (less than 0.0005)
Hexavalent Chromium	*mg/l*	ND (less than 0.02)
Arsenic	*mg/l*	ND (less than 0.005)
Fluorine	*mg/l*	0.38
Total Cyanide	*mg/l*	ND (less than 0.01)

Table-II.3.5 Result of Microscopic Examination

	Species	Result
Schizomycetes	Short-rod Bacillus	++++
Rhizopodea	Difflugia sp.	+
Flagellata	Bodo sp.	++
	Oikomonas sp.	++
Cyanophyceal	Aphanocapsa sp.	+++
	Aphanothece stagnina	++
	Chroococcus sp.	++
	Anabaena sp.	+
	Phormidium sp.	+
Chlorophyceal	Scenedesmus opoliensis	+
Bacillariophyceal	Melosira granulata	++
	Melosira italica	+
	Melosira varians	+
	Cyclotella kuetzingiana	+
	Cyclotella stelligera	+
	Coscinodiscus sp.	+
	Cocconeis placentula	+
	Navicula radiosa	+

+: very small quantity, ++: small quantity, +++: average
++++: large quantity, +++++: very large quantity

Table II.3.6 Utilization of the Existing Facilities

Item	Utilization	Remarks
1. Diesel Engines	N. U.	Uncompleted
2. Generators	N. U.	Uncompleted
3. Auxiliary Equipment for Engines	N. U.	Uncompleted and damaged by corrosion
4. Auxiliary Equipment for Generators	N. U.	Uncompleted and deterioration of insulation level
5. Control and Protection Equipment	N. U.	Not yet provided
6. Miscellaneous Materials such as cables, etc.	N. U.	Uncompleted, disordered and mostly damaged
7. Overhead Traveling Crane (16 tons)	O. K.	
8. Fuel Storate Tank	N. U.	Uncompleted and damaged by corrosion
9. Cooling Water Pond	N. U.	Not yet constructed.
10. Piping System for Diesel Engines	N. U.	Uncompleted and damaged by corrosion
11. Switchboards	N. U.	Not yet provided
12. Power House, Control Room, Operation Building, etc.	O. K.	Structures are useful. Additional works are required. (finishing, doors, windows, lighting, air conditioners, grounding wires, etc.)
13. Foundations	O. K.	Additional works are requried. (finishing, anchor holes, etc.)
14. Main Transformers	N. U.	Deterioration of insulation level of coil
15. Security System	N. U.	Fences, guard house, etc. not yet constructed

(Note) N. U. : Not possible to use
O. K. : Possible to use

Table II.3.7 Lighting Facilities

	Room	Illumination Level	Fixture
1	D/G Room	100	400W mercury lamp
2	H. V Room	150	40W fluorescent lamp
3	Warehouse	300	40W fluorescent lamp
4	Staff Room	300	40W fluorescent lamp
5	Lavatory	150	20W fluorescent lamp
6	Corridor	150	20W fluorescent lamp
7	Control Room	500	40W fluorescent lamp
8	Working Room	500	40W fluorescent lamp
9	Office	500	40W fluorescent lamp
10	Access Road	10	400W mercury lamp
11	Cooling Tower	10	400W mercury lamp
12	Tank	10	400W mercury lamp
	Emergency Light (2-9)	15	20W fluorescent lamp
	Emergency Light (1)	5	30W portable lamp
	Exit Light		20W fluorescent lamp

Table-II.3.8(A) Major Materials and Equipment to be Provided (First Stage) (1/2)

Description	Quantity	Unit
A) Generating Facilities		
1) Diesel Engine 7,090 PS	1	No.
2) Compressed Air Starting System	1	Set
3) Fuel Oil Supply System		
Fuel Oil Tank 1,000 kl	1	Set
Fuel Oil Buffer Tank	1	No.
Fuel Purifier Unit	1	Set
Fuel Filter	1	Set
4) Lubricating Oil System		
Sump Tank	1	No.
Lubricating Oil Cooling Unit	1	Set
Lubricating Oil Filter	1	Set
Lubricating Oil Purifier Unit	1	Set
Sludge Collecting Tank	1	No.
5) Cooling Water System		
Cooling Water Tank	1	No.
River Water Treatment Unit	1	Set
City Water Purifier Unit	1	Set
Cooling Tower	1	No.
6) Intake Exhaust Air System		
Exhaust Air Duct	1	Set
Intake Air Duct	1	Set
Air Filter	1	No.
Intake Silencer	1	No.
Exhaust Silencer	1	Set
7) Sludge Treatment System	1	Set
8) Synchronous Generator 5,000kW	1	No.
9) Exciter Cubicle	2	Nos.
10) Syncronizing Panel	1	No.
11) Generator Control Panel	2	Sets
12) Switchboards for Generator (6.3kV)	2	Nos
13) Feeder Control Panel	1	Set

Table-II.3.8(A) Major Materials and Equipment to be Provided (First Stage) (2/2)

Description	Quantity	Unit
14) Step-up Transformer 15/6.3kV 6,300kVA	1	No.
15) Station Service Transformer 6.3kV/400-230V 630kVA	1	No.
16) Switchbords for Station Service Transformer (6.3kV)	2	Nos.
17) Switchboards for Step-up Transformer (6.3kV)	2	Nos.
18) Low Voltage Cubicles (400/230V)	2	Nos.
19) Motor Control Center	1	Set
20) DC Power Supply Unit (Battery and Charger) DC110V	1	Set
21) Maintenance Tools, Measuring Instruments & Spare Parts	1	Set
B) Distribution Line Facilities		
1) 20kV Power Cable 3C-150 sq.mm	6.90	km
2) Pole Transformer 15kV/380-220V 250 kVA	1	Nos.
3) Feeder Cubicle (15kV)	11	Nos.
4) Measuring Instruments	1	Set

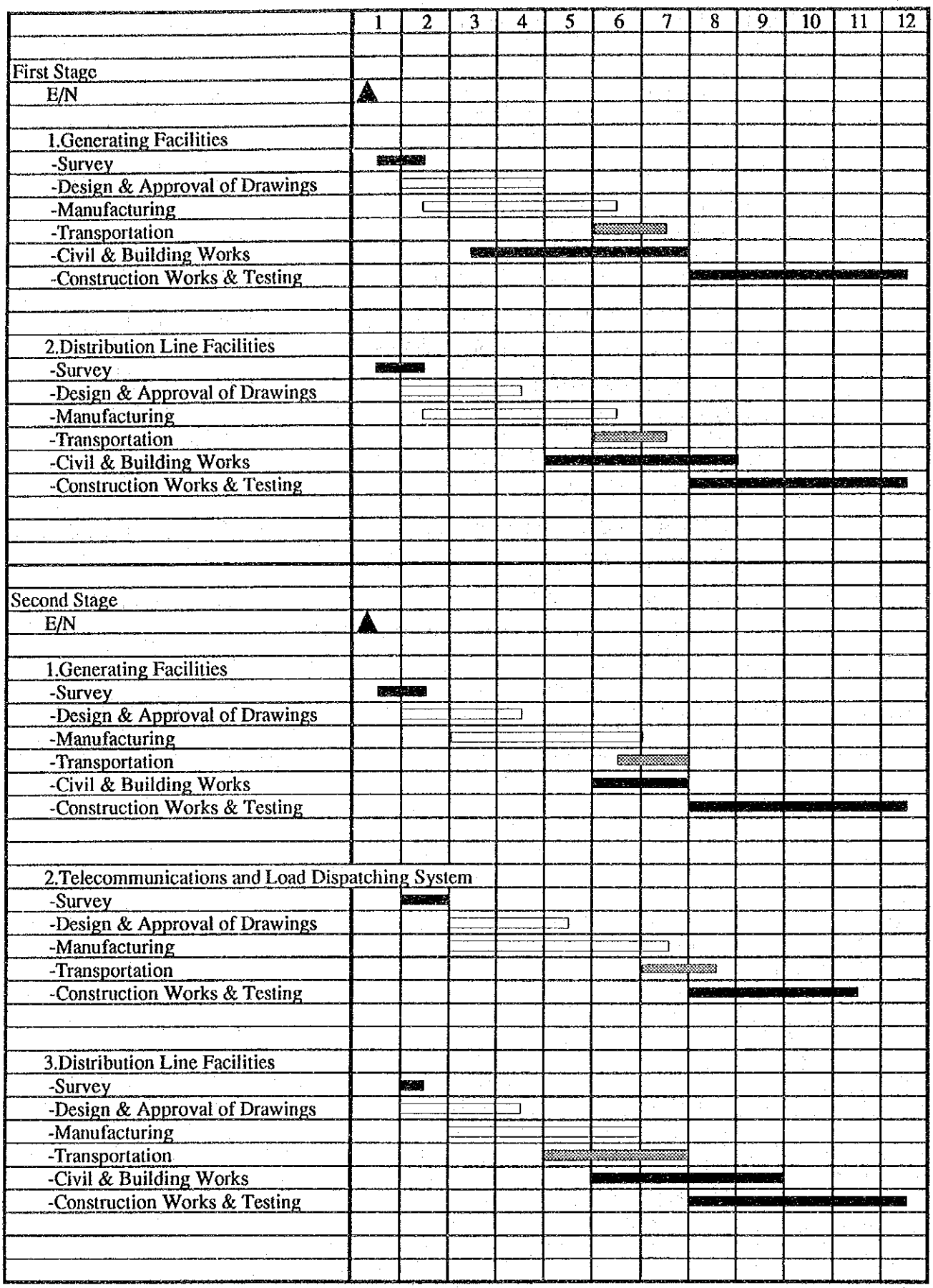
Table-II.3.8(B) Major Materials and Equipment to be Provided (Second Stage) (1/2)

Description	Quantity	Unit
A) Generating Facilities		
1) Diesel Engine 7,090 PS	1	No.
2) Compressed Air Starting System	1	Set
3) Fuel Oil Supply System		
Fuel Oil Tank 1,000 kl	1	Set
Fuel Purifier Unit	1	Set
Fuel Filter	1	Set
4) Lubricating Oil System		
Sump Tank	1	No.
Lubricating Oil Cooling Unit	1	Set
Lubricating Oil Filter	1	Set
Lubricating Oil Purifier Unit	1	Set
5) Cooling Water System		
Cooling Tower	1	No.
6) Intake Exhaust Air System		
Exhaust Air Duct	1	No.
Intake Air Duct	1	Set
Air Filter	1	No.
Intake Silencer	1	No.
Exhaust Silencer	1	Set
7) Synchronous Generator 5,000kW	1	No.
8) Step-up Transformer 15/6.3kV 6,300kVA	1	Set
9) Station Service Transformer 6.3kV/400-230V 630kVA	1	No.
10) Maintenance Tool, Measuring Instrument & Spare Parts	1	Set
B) Telecommunications and Load Dispatching System		
1) Fixed Radio Station Facility for LDC	1	Set
2) Collective Supervisory Board	1	Set
3) Fixed Radio Station Facilities for Power Stations	5	Sets
4) Mobile Radio Facilities (car mounted type)	4	Sets
5) Maintenance Tools	1	Set

Table-II.3.8(B) Major Materials and Equipment to be Provided (Second Stage) (2/2)

Description	Quantity	Unit
C) Distribution Line Facilities		
1) 20kV Overhed Line Supports		
2CCT Poles at Straight Point of the Lines	307	Sets
2CCT Light Angle Point of the Lines	27	Sets
2CCT Heavy Angle Point of the Lines	38	Sets
2CCT Poles at Dead-end Point of the Lines	6	Sets
2) Conductor HAL 120 sq.mm	113.1	km
3) 20kV Overhed Line Supports		
1CCT Poles at Straight Point of the Lines	19	Sets
1CCT at Light Angle Point of the Lines	1	Set
1CCT Poles at Dead-end Point of the Lines	4	Sets
4) Conductor HAL 120 sq.mm	3.78	km
5) 20kV Power Cable 3C-150 sq.mm	1.45	km
6) Pole Transformer 15kV/380-220V 250 kVA	2	Nos.
7) Feeder Cubicle (15kV)	10	Nos.
8) Maintenance Tools	1	Set

Table II.3.9 Implementation Schedule



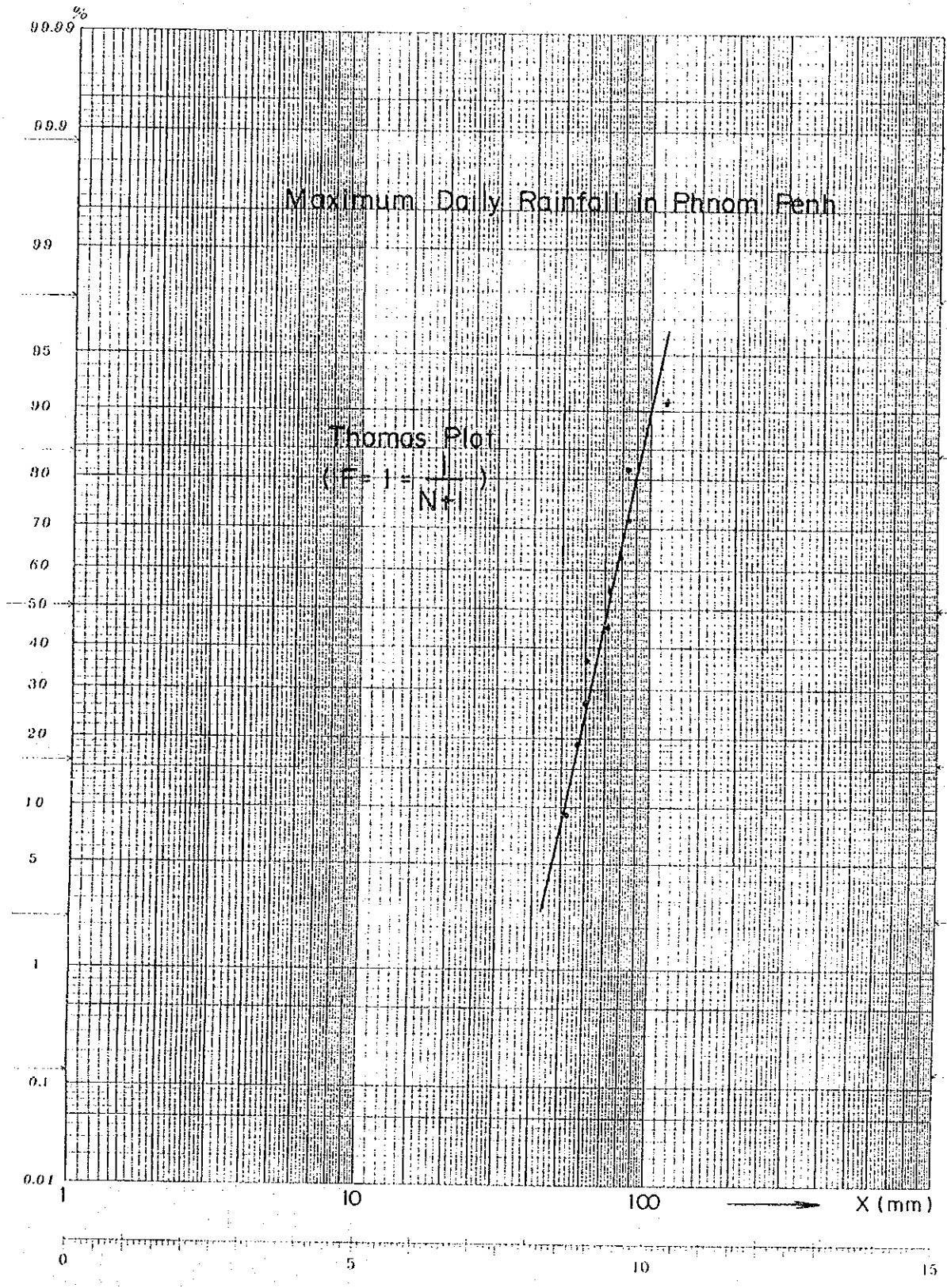


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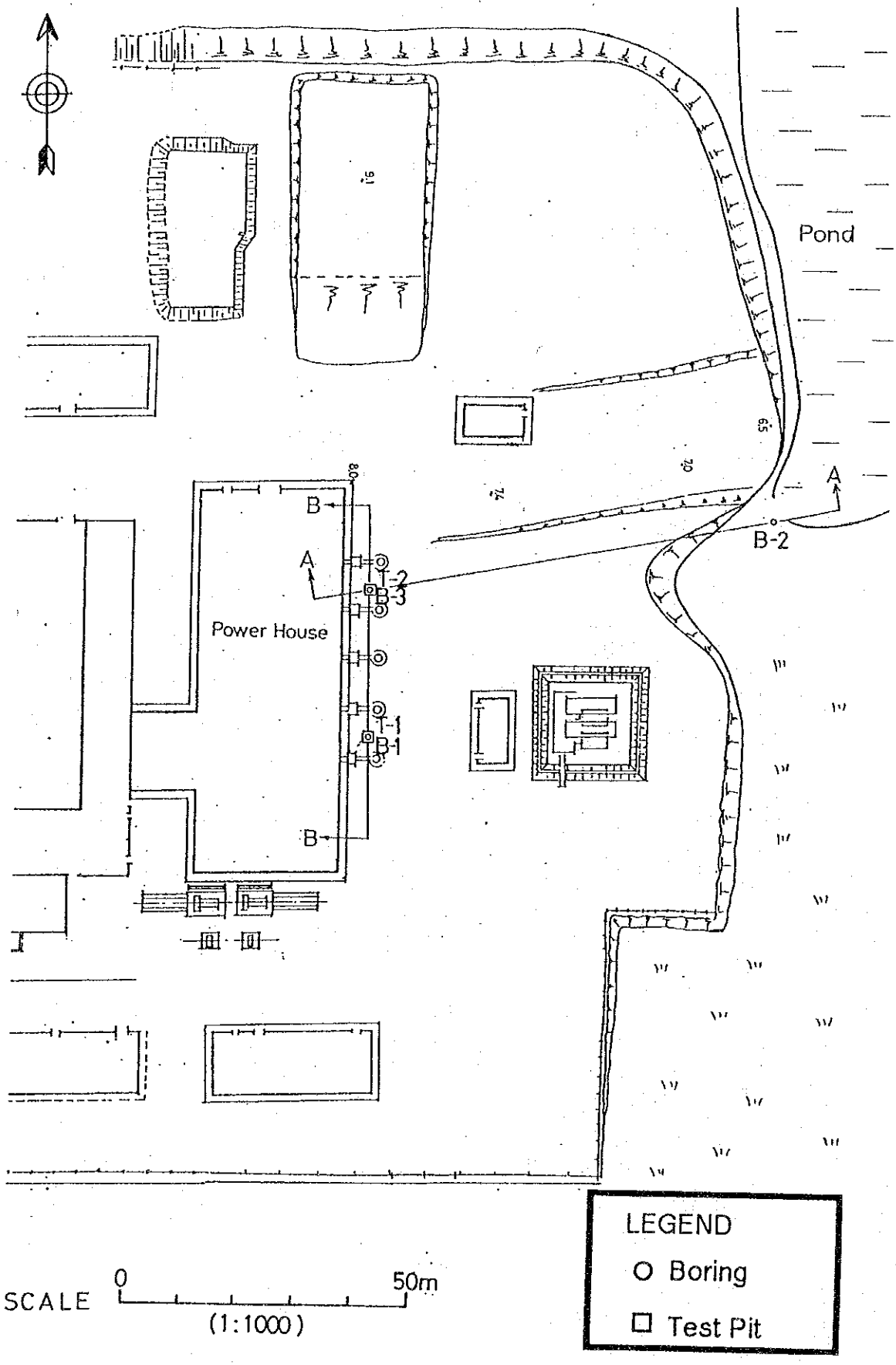
Figure II.3.1
MAXIMUM DAILY RAINFALL
IN PHNOM PENH



TITLE Figure II.3.2
EXISTING LAYOUT OF NO.5 P/S
& BORE HOLE POINTS

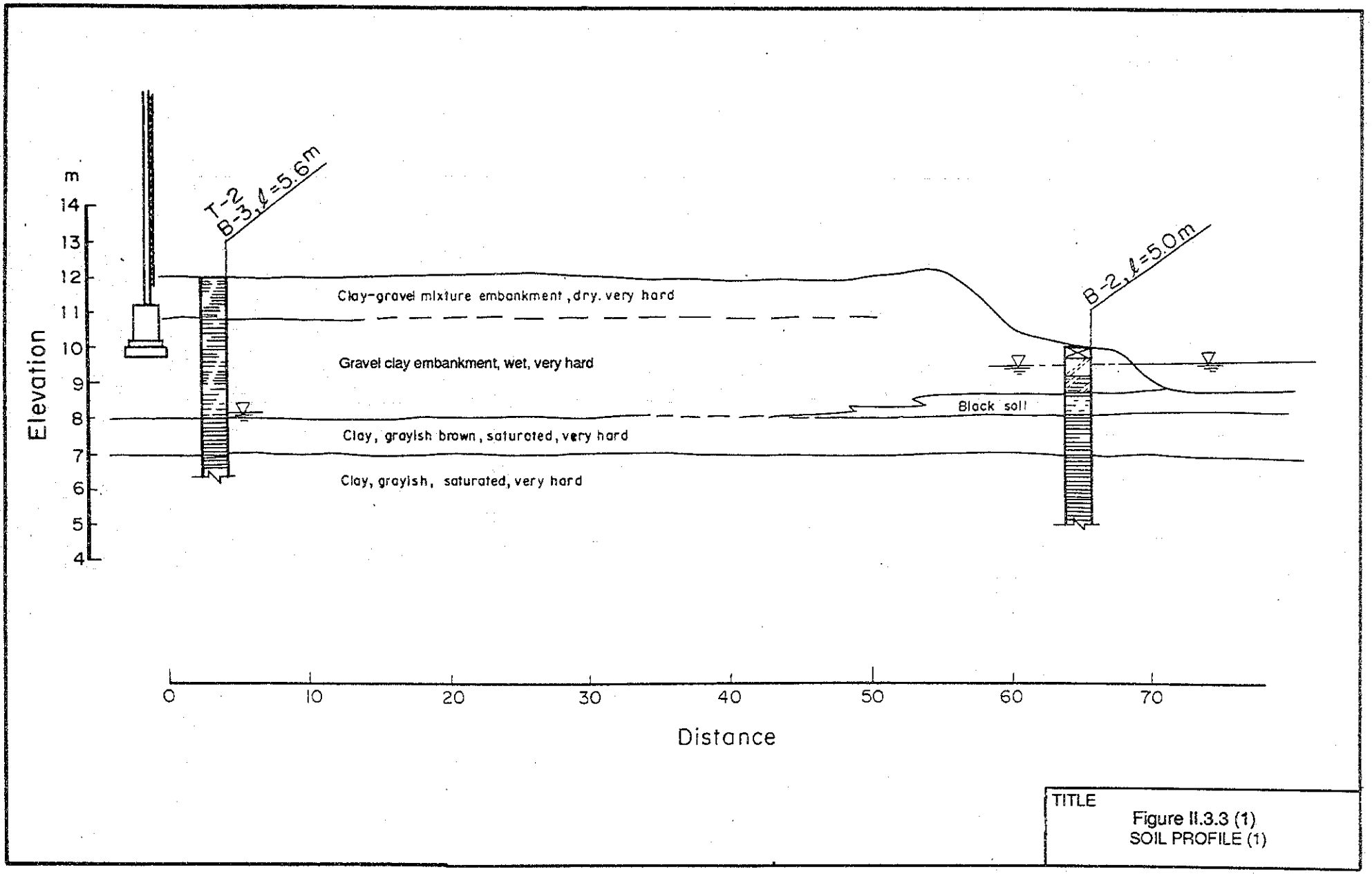


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Figure II.3.3 (1)
SOIL PROFILE (1)

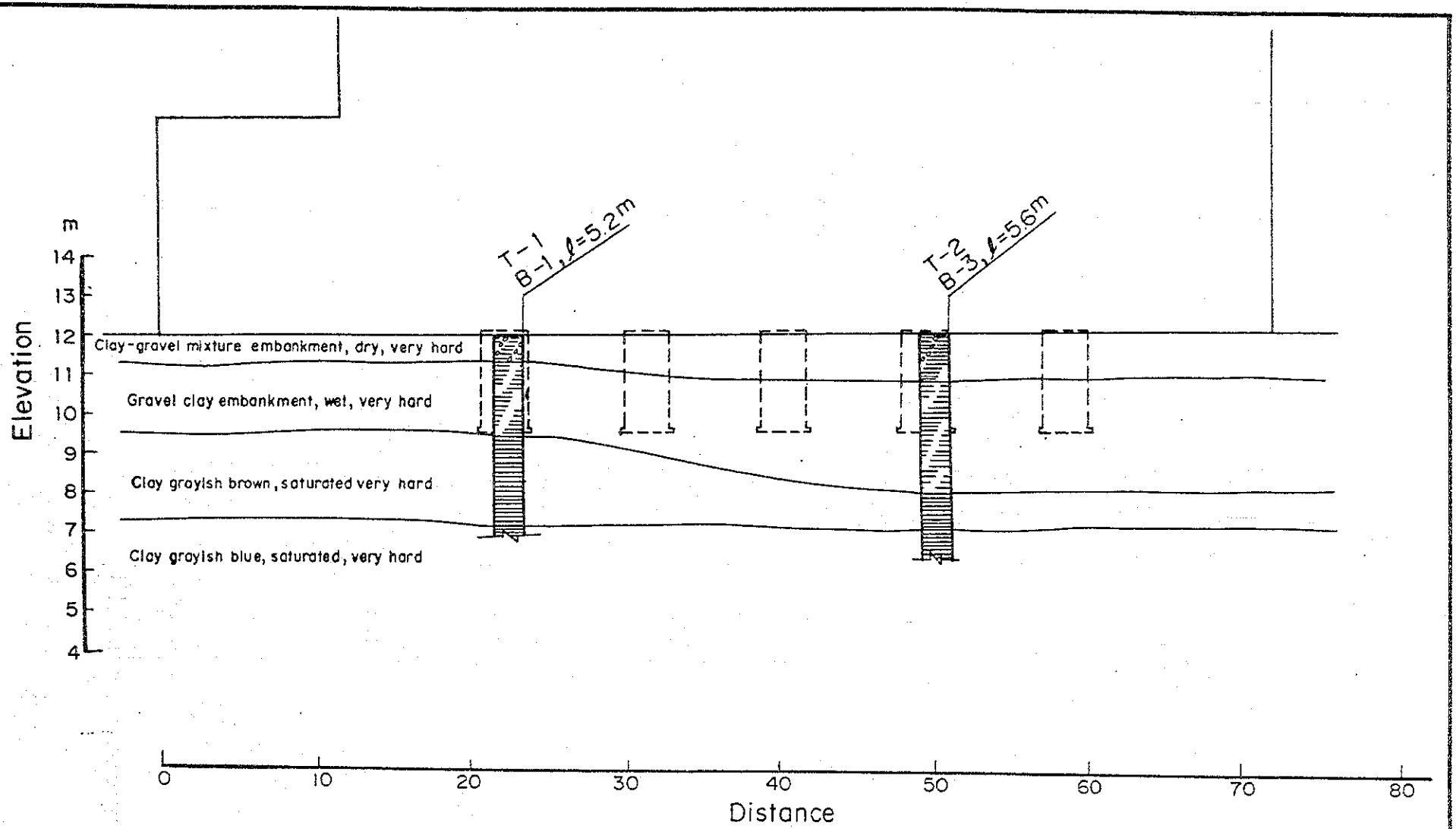

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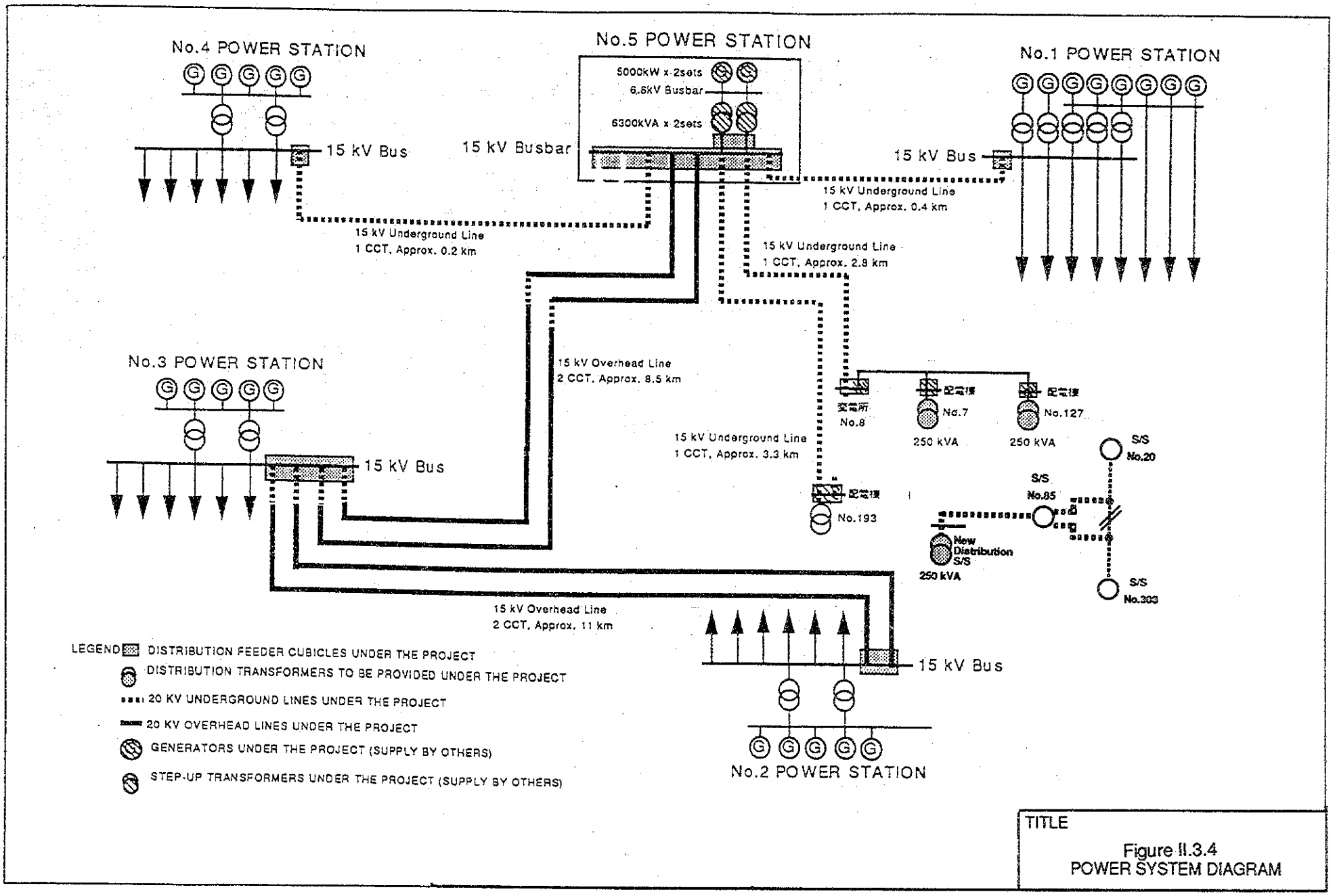
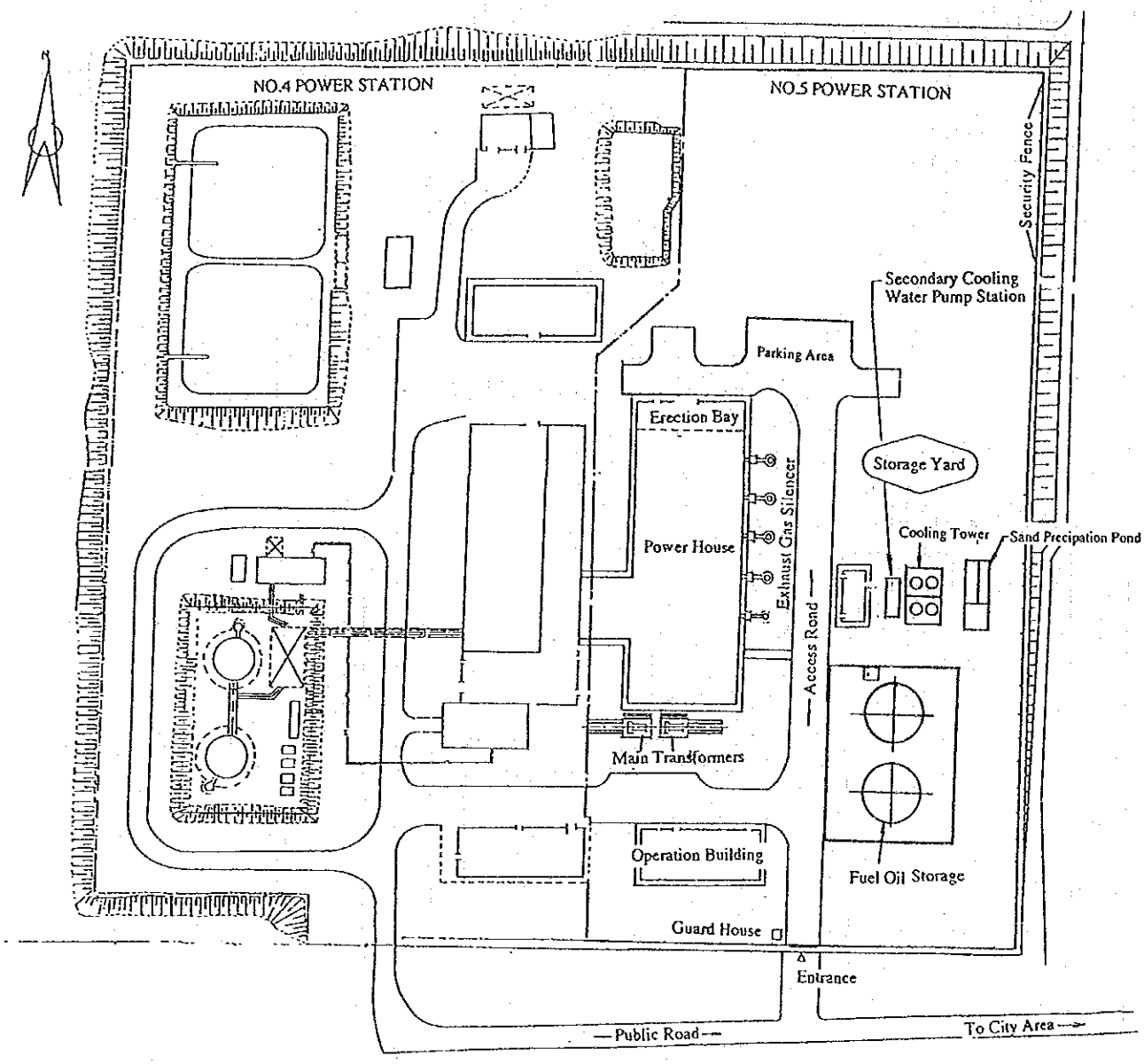
Figure II.3.3 (2)
SOIL PROFILE (2)



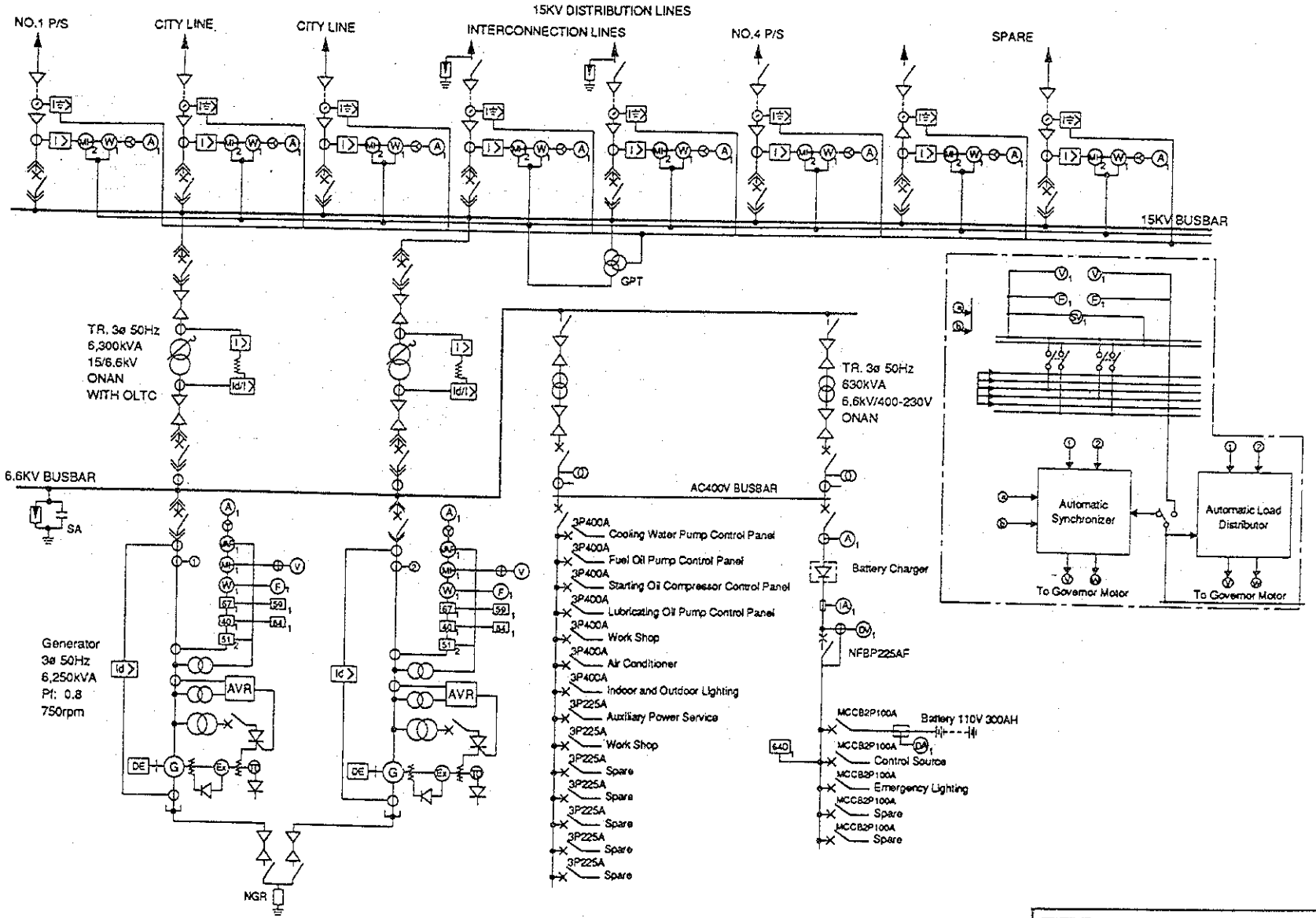
TITLE

Figure II.3.4
POWER SYSTEM DIAGRAM



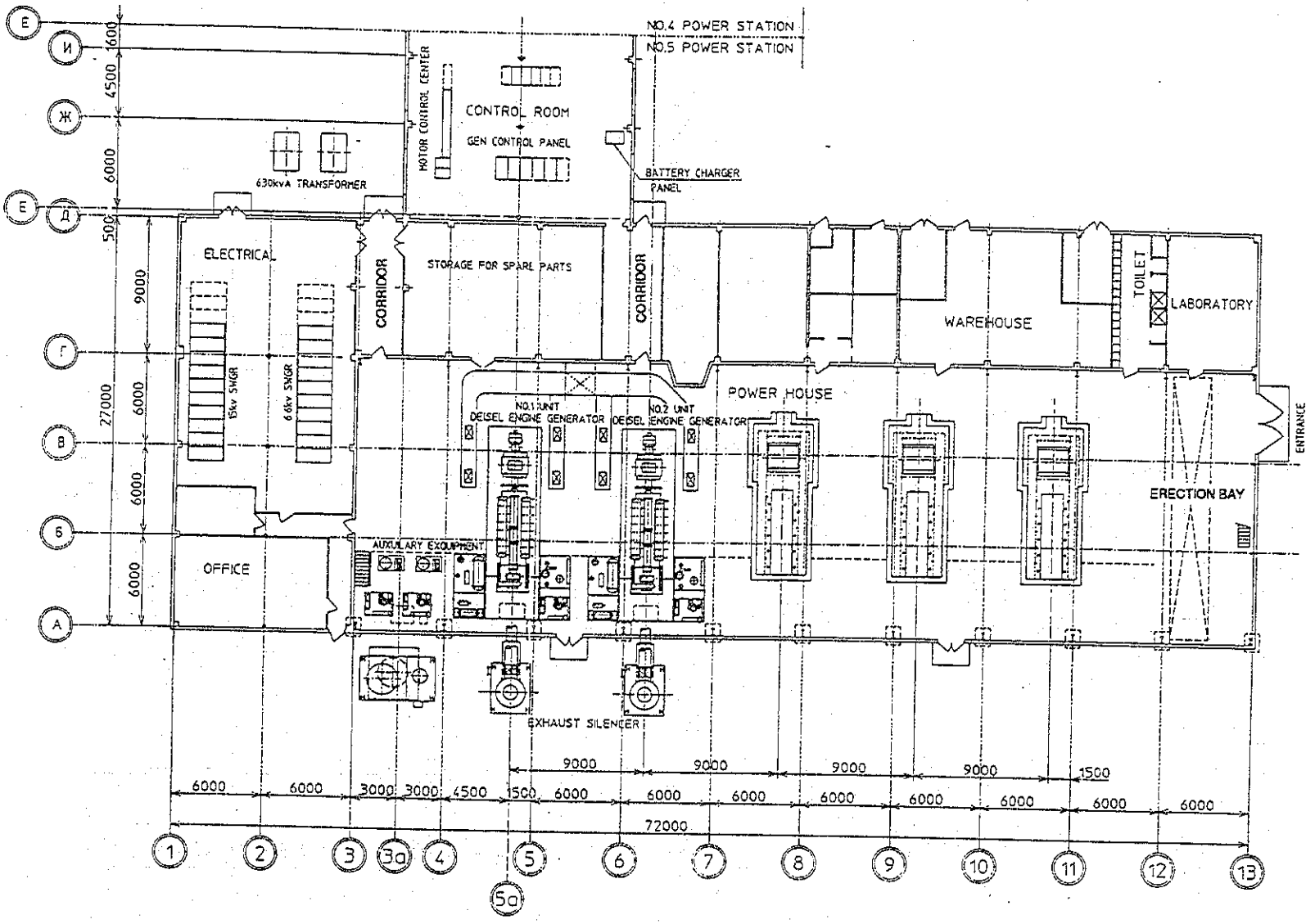
TITLE

Figure II.3.5
LAYOUT OF NO.5 P/S



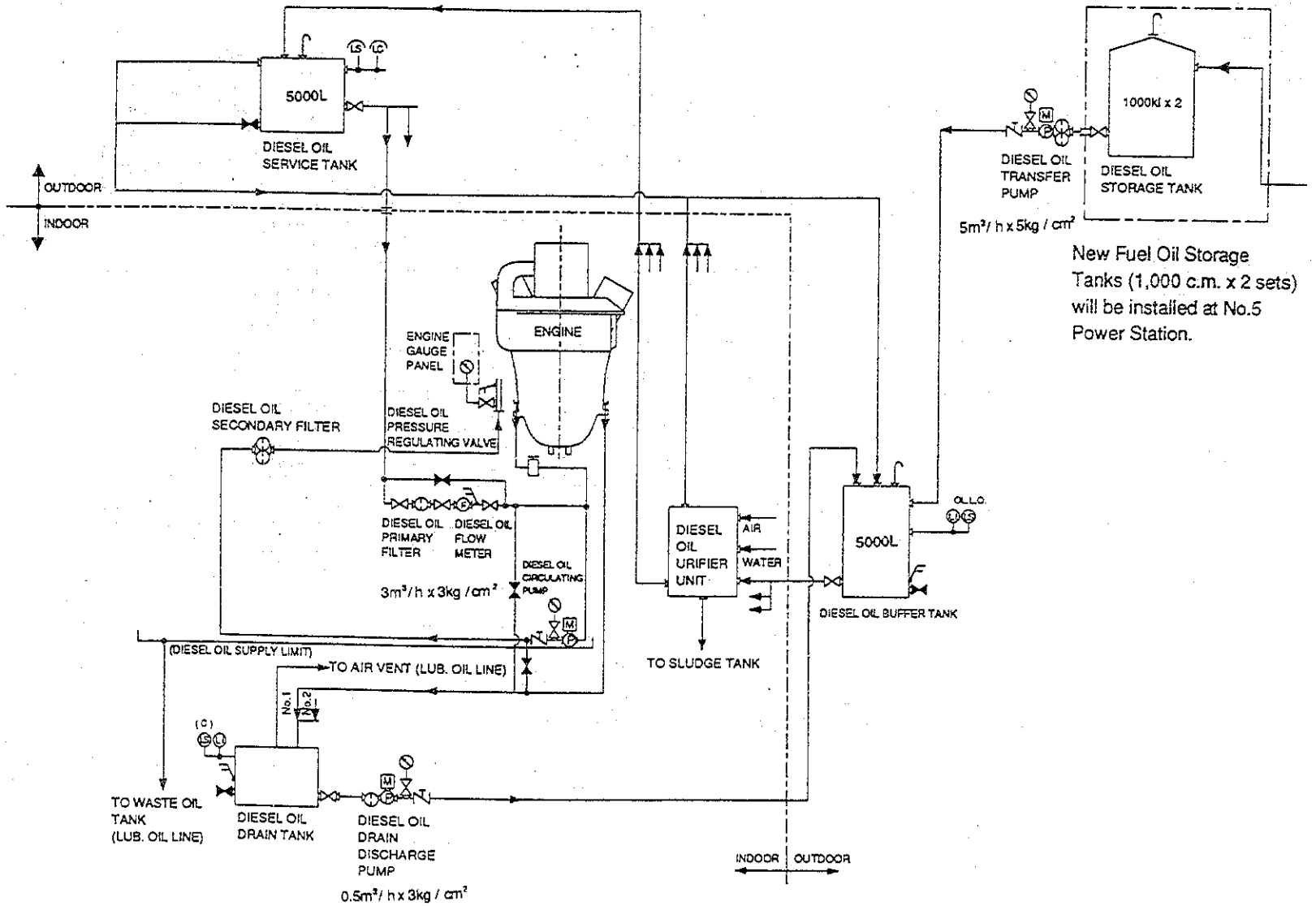
TITLE

Figure II.3.6
SINGLE LINE DIAGRAM



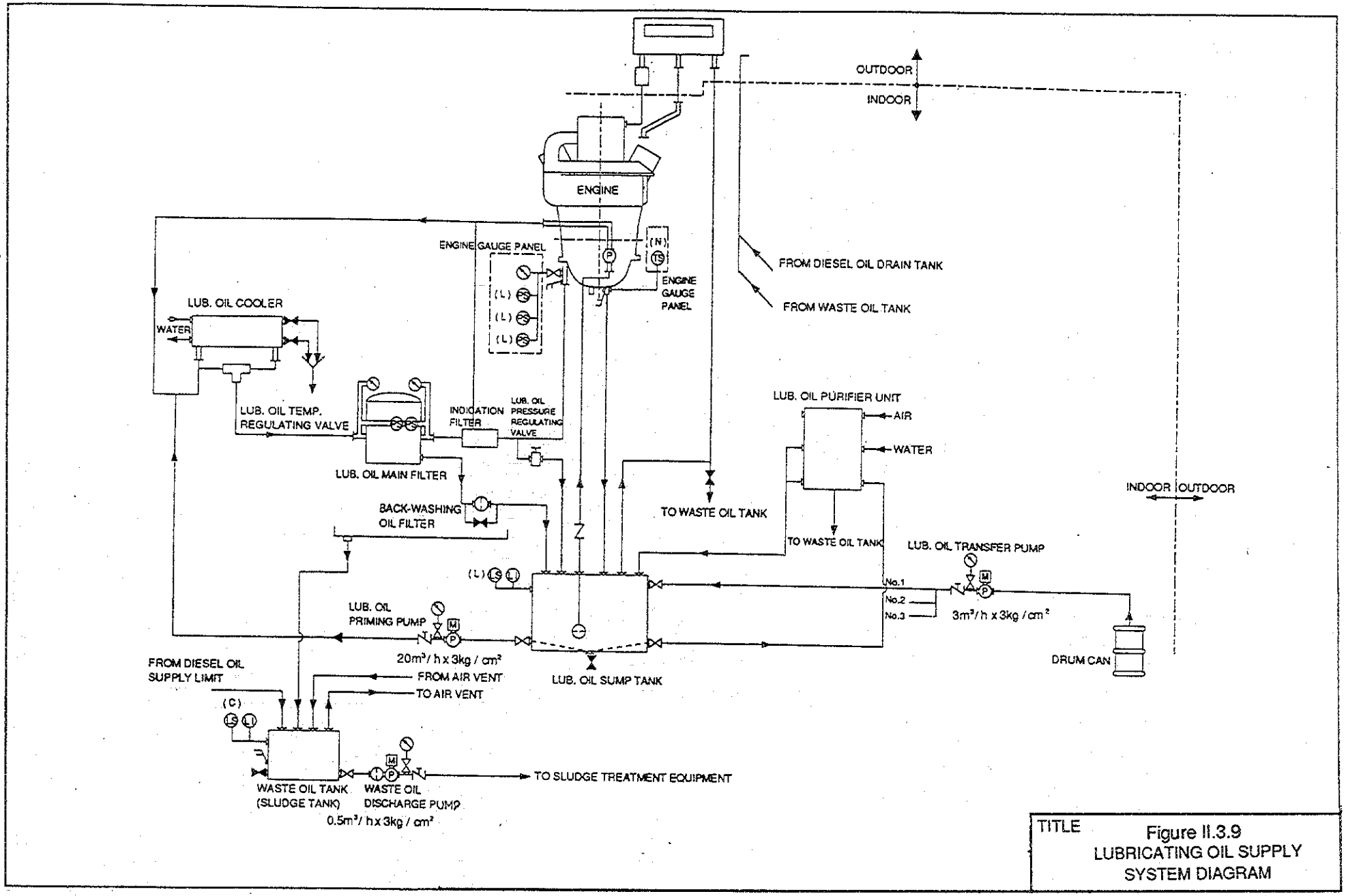
TITLE

Figure II.3.7
ARRANGEMENT OF EQUIPMENT



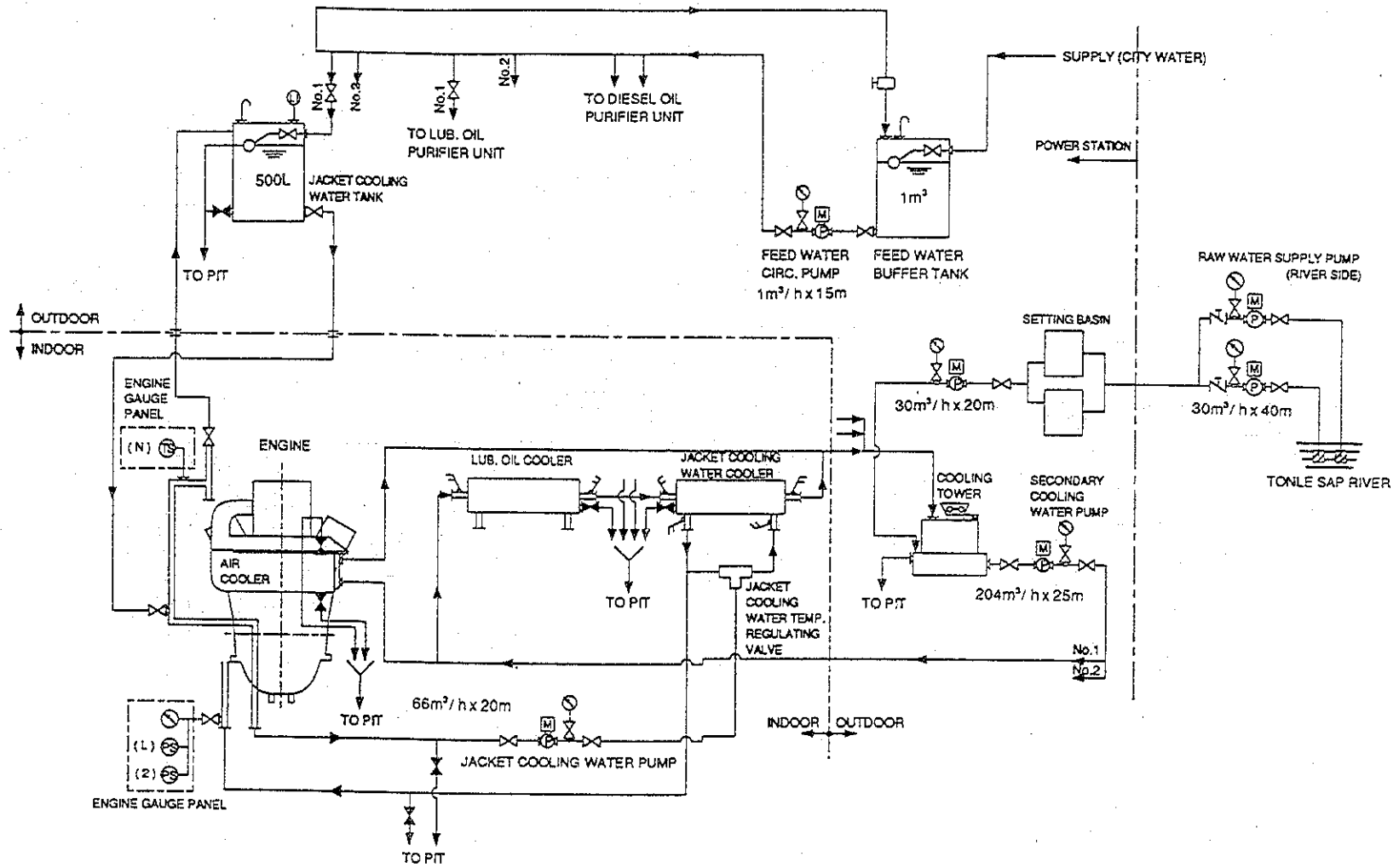
TITLE

Figure II.3.8
FUEL OIL SUPPLY SYSTEM DIAGRAM

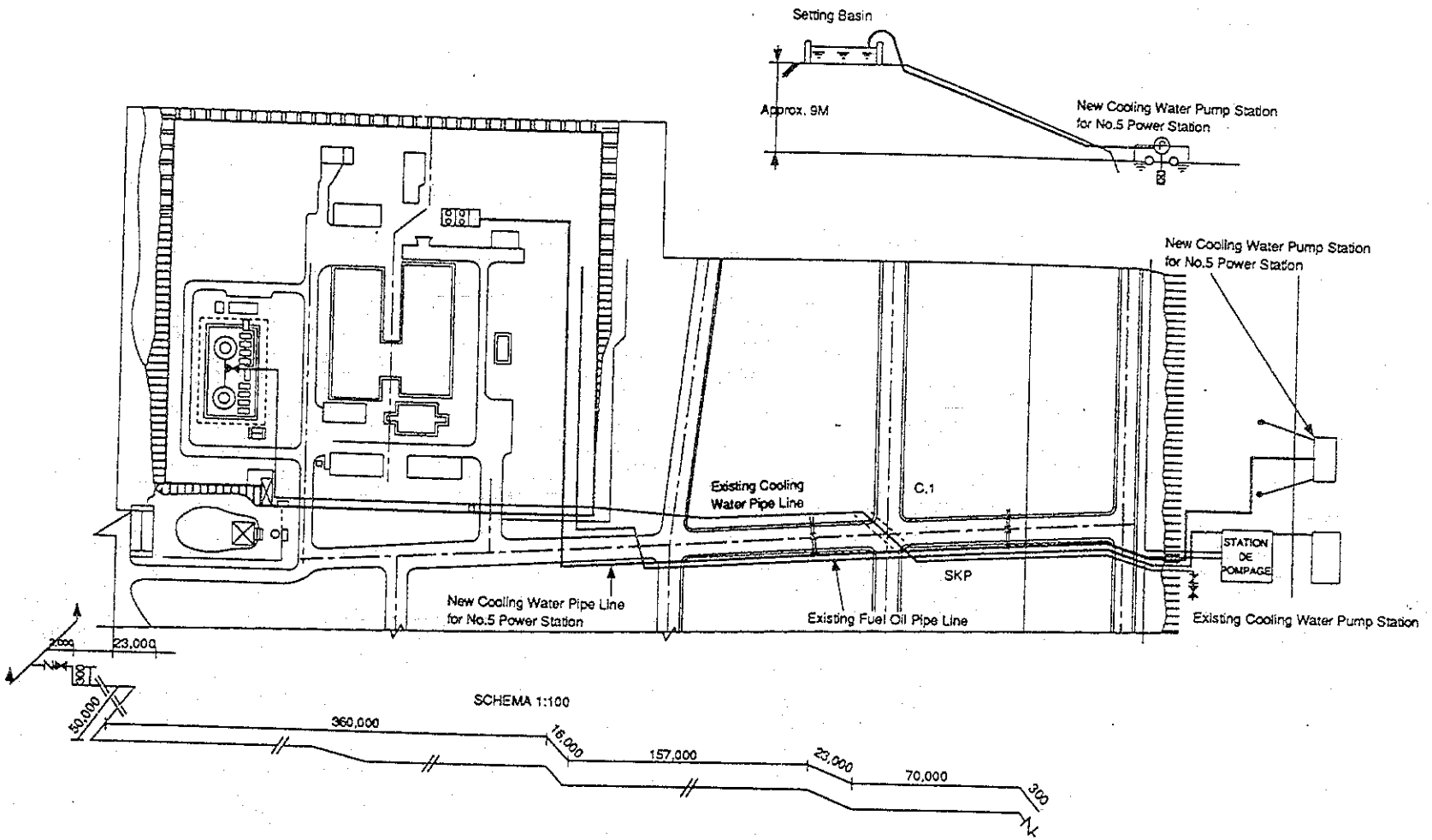


TITLE

Figure II.3.9
LUBRICATING OIL SUPPLY SYSTEM DIAGRAM

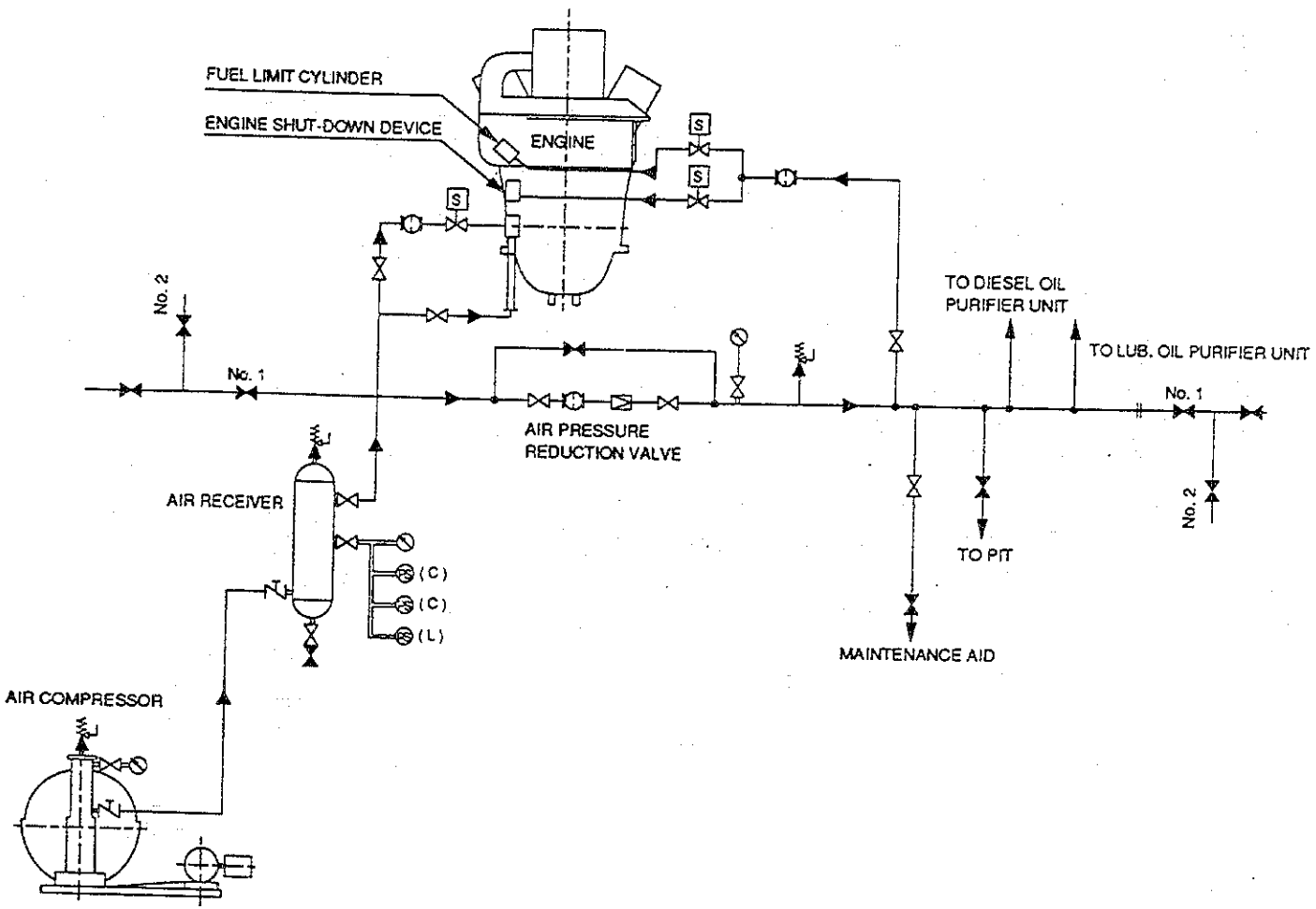


TITLE Figure II.3.10
COOLING WATER SUPPLY SYSTEM DIAGRAM



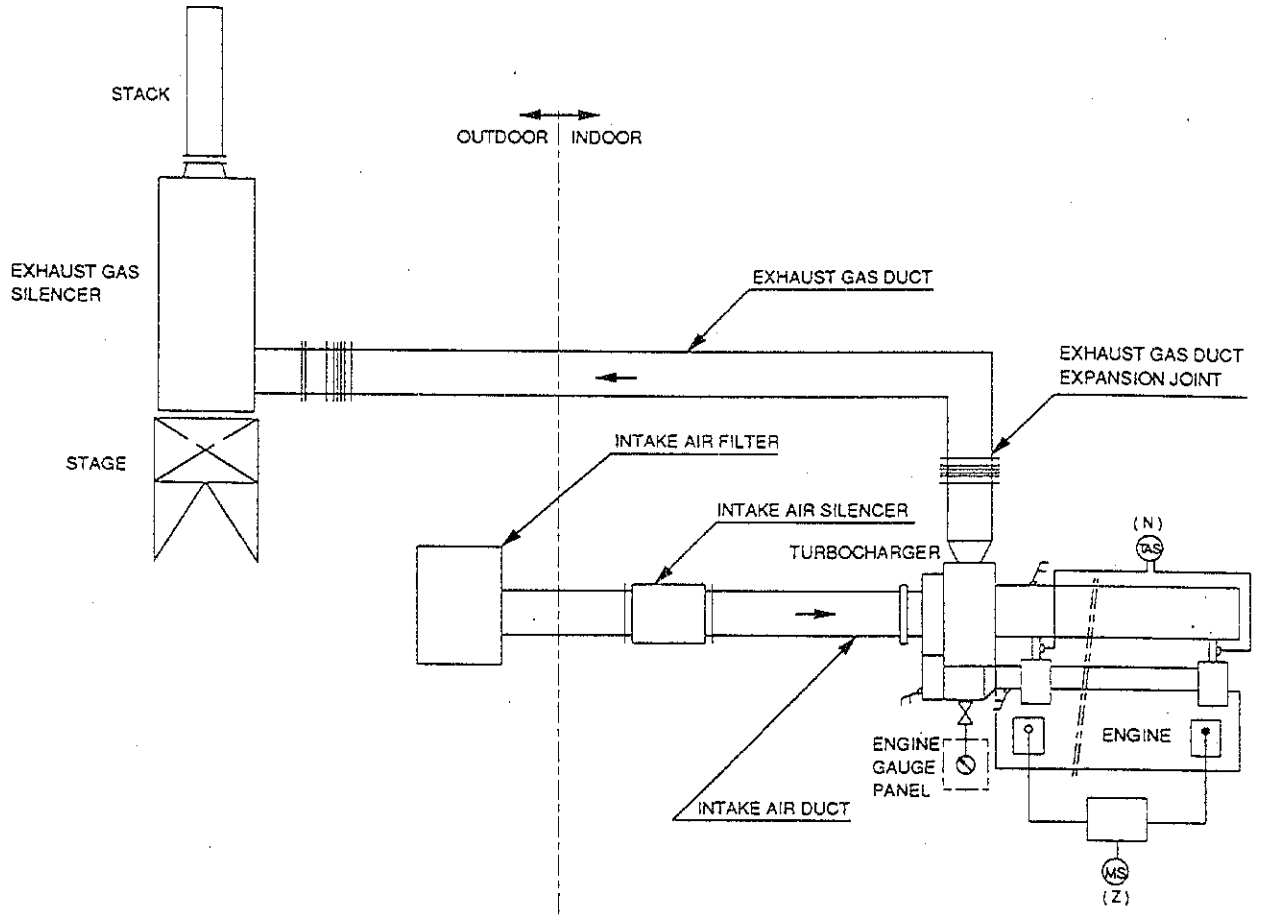
TITLE

Figure II.3.11
LAYOUT OF PIPE LINE &
PUMP STATION



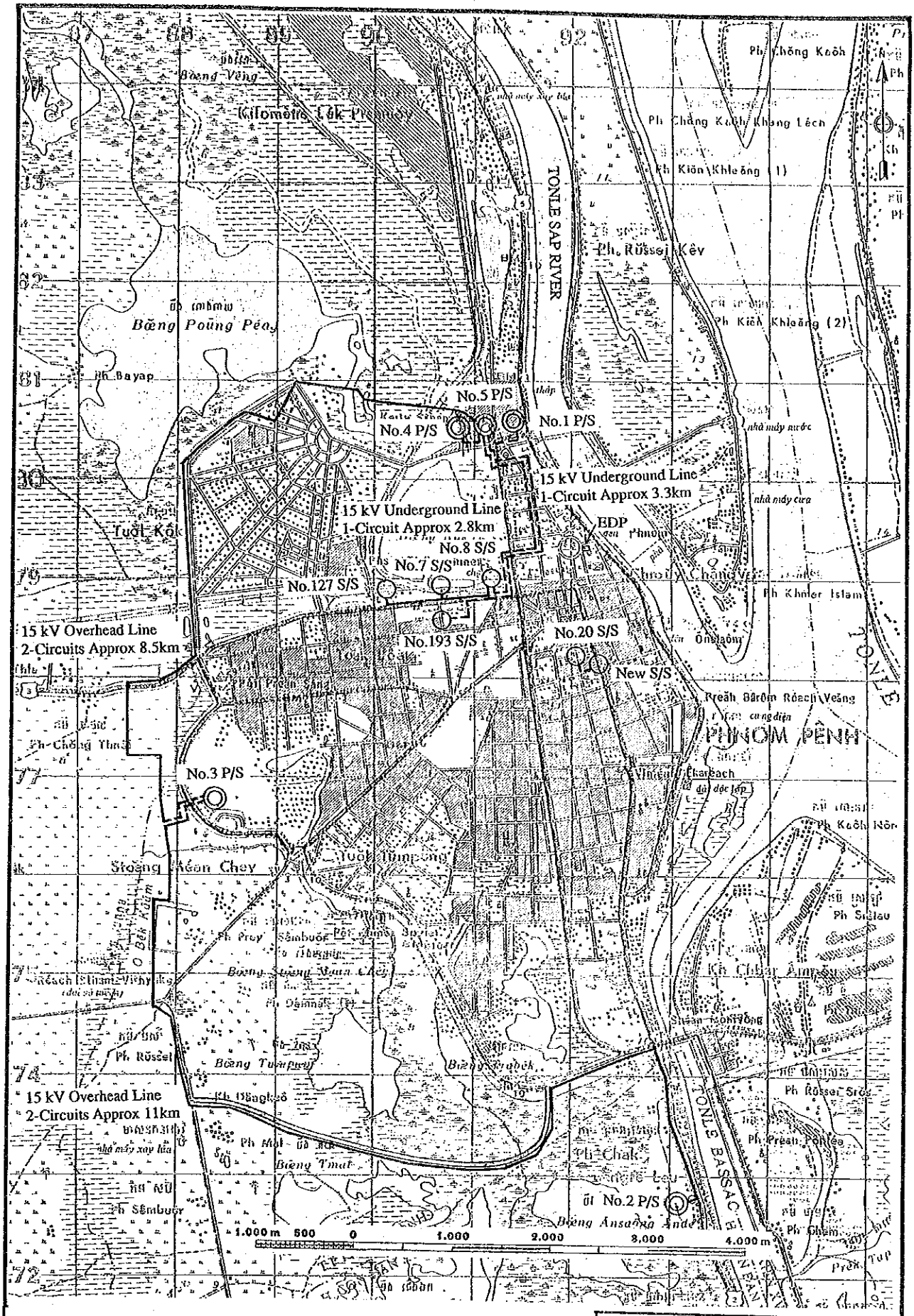
TITLE

Figure II.3.12
COMPRESSED AIR SUPPLY
SYSTEM DIAGRAM



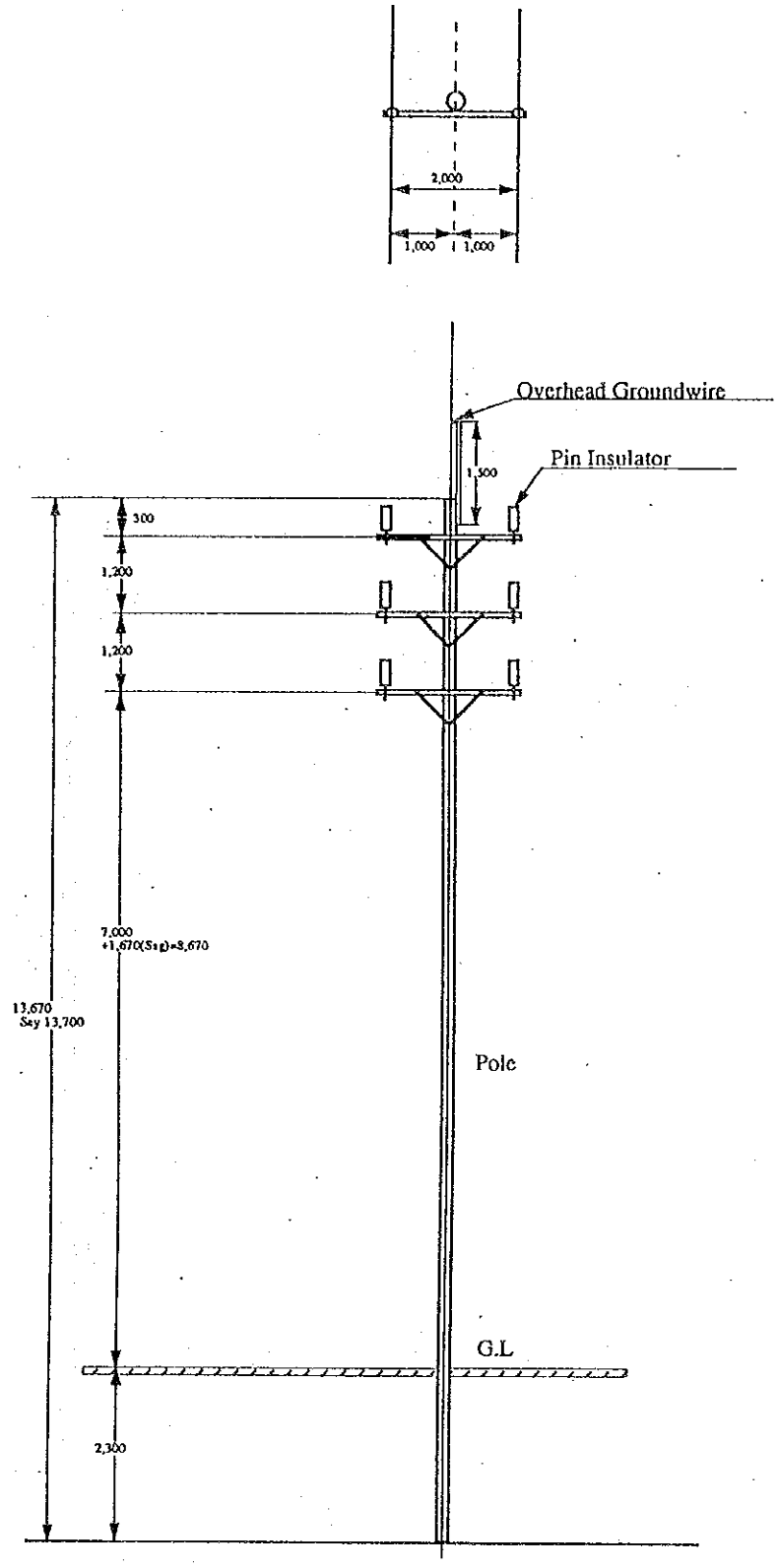
TITLE

Figure II.3.13
AIR INTAKE & EXHAUST SYSTEM DIAGRAM



TITLE Figure II.3.14
LAYOUT OF DISTRIBUTION LINE FACILITIES & ROUTE MAP

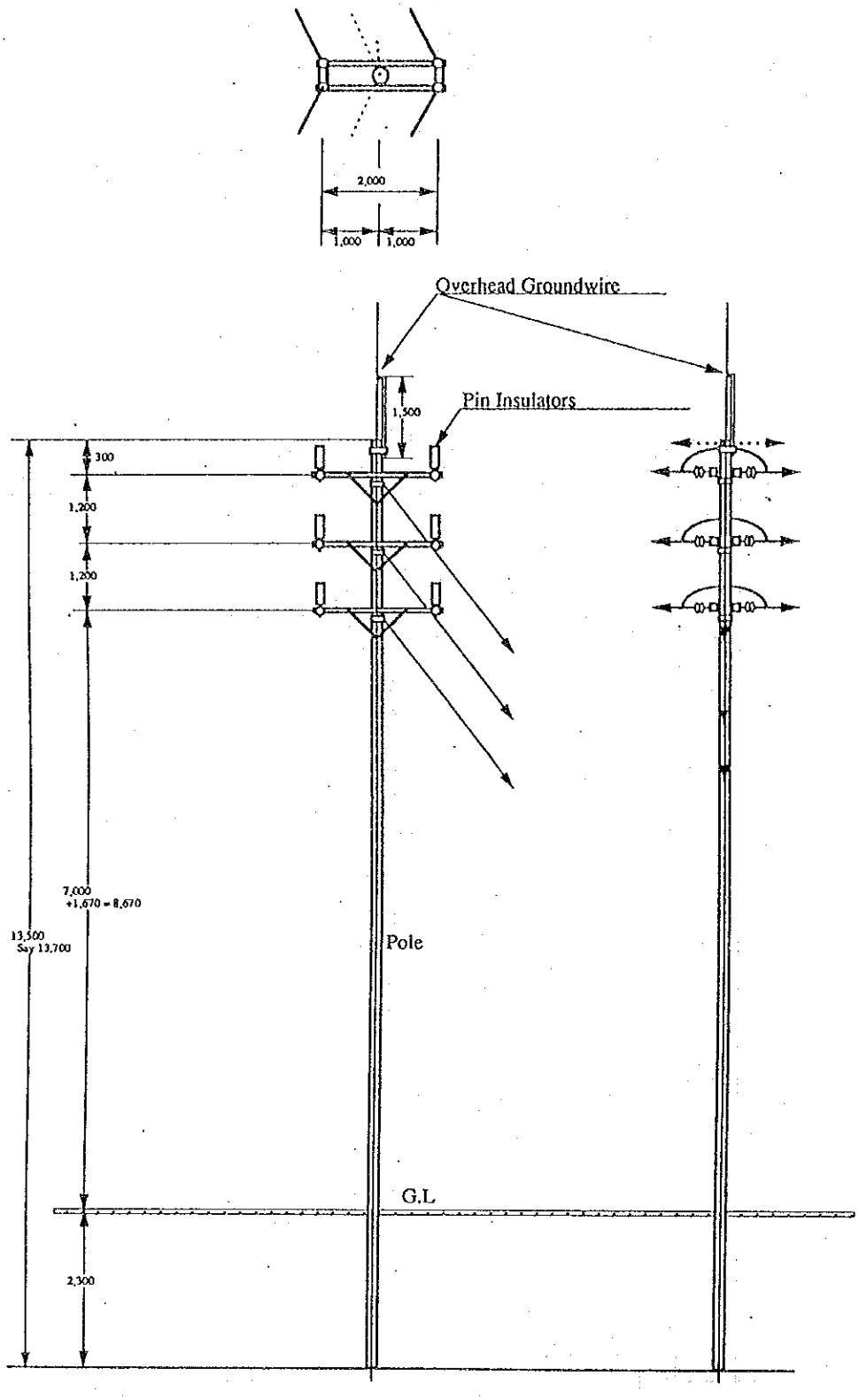
REFERENCE ONLY



Streight Type Pole (Type-S)

TITLE	Figure II.3.15 POLE ASSEMBLY (STRAIGHT LINE POLE)

REFERENCE ONLY



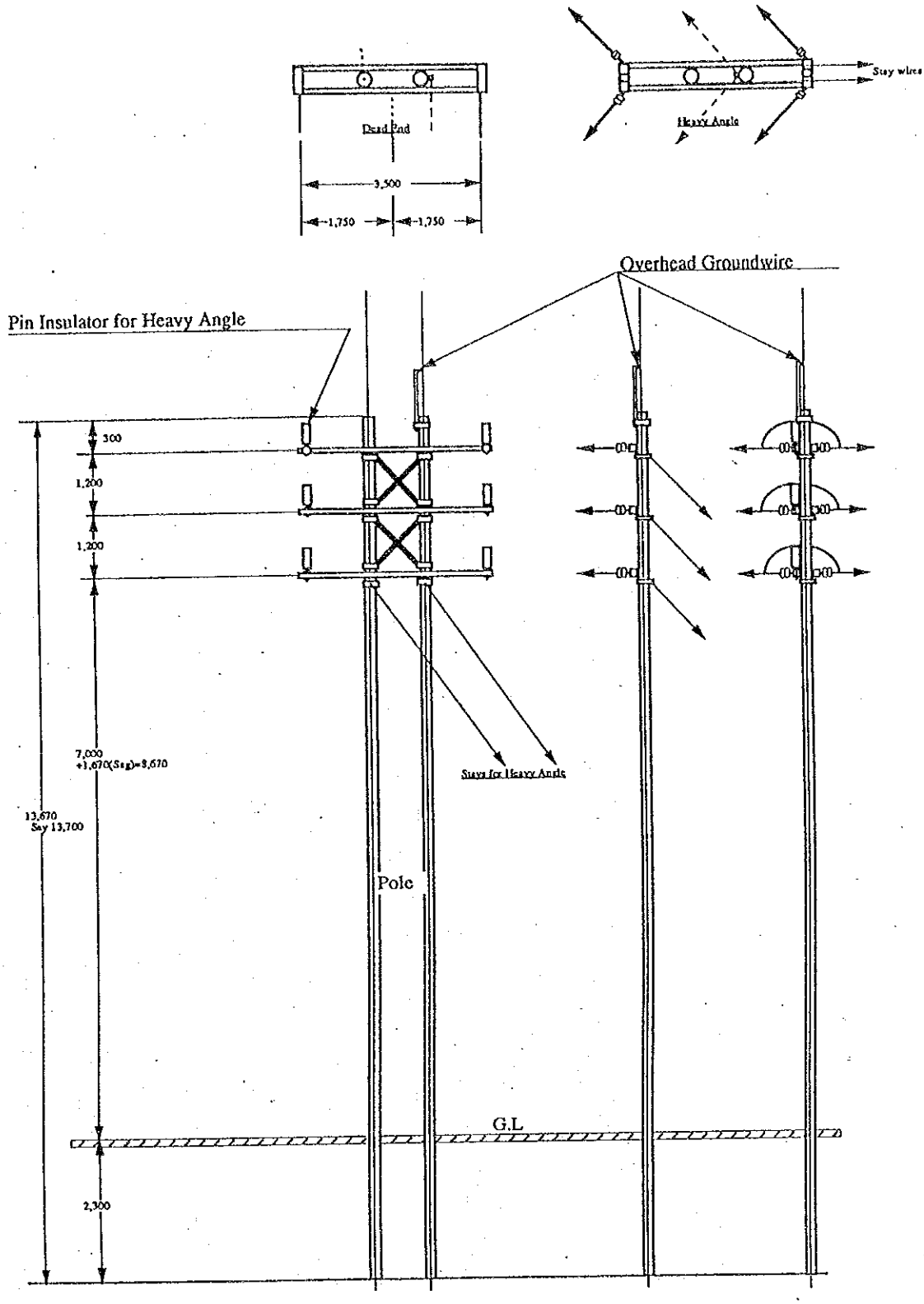
Angle Type Pole (Type-A)

TITLE

Figure II.3.16

POLE ASSEMBLY (ANGLE LINE POLE)

REFERENCE ONLY

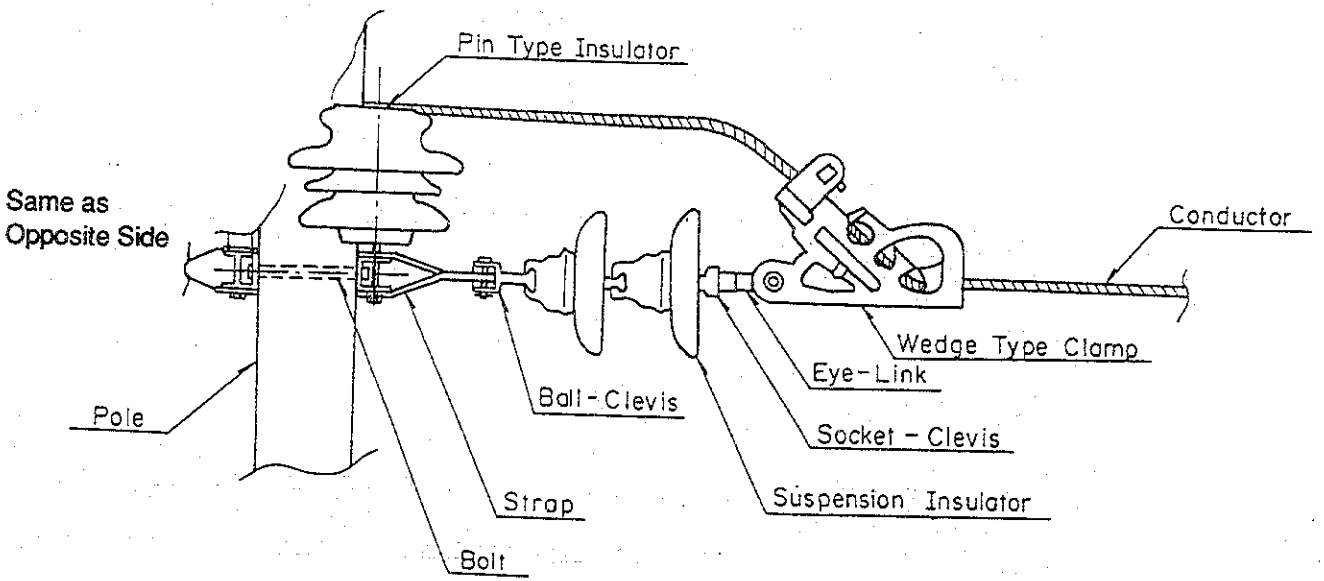


Dead End(Heavy Angle)Type Pole
(Type-HA & D)

Dead End

Heavy Angle

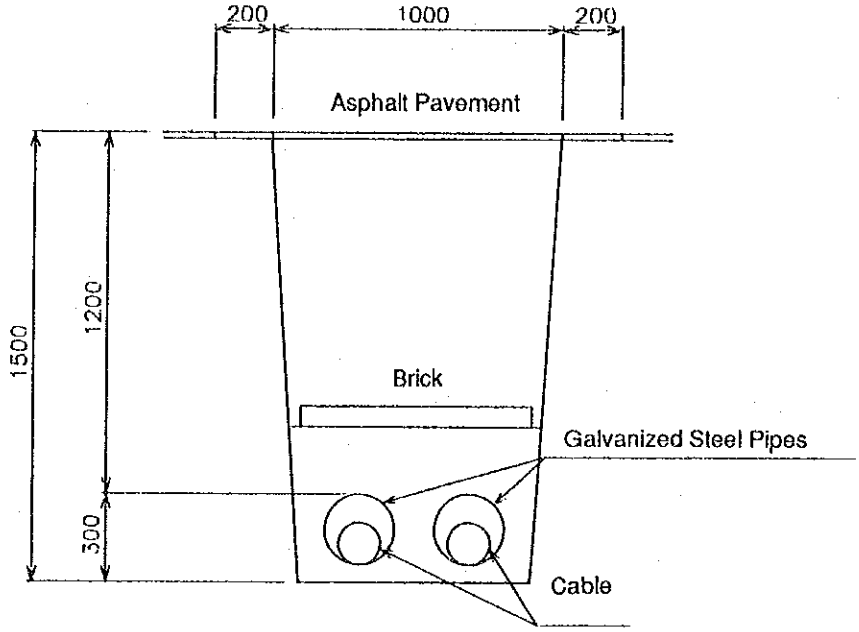
TITLE Figure II.3.17
POLE ASSEMBLY
(DEAD END & HEAVY ANGLE POLE)



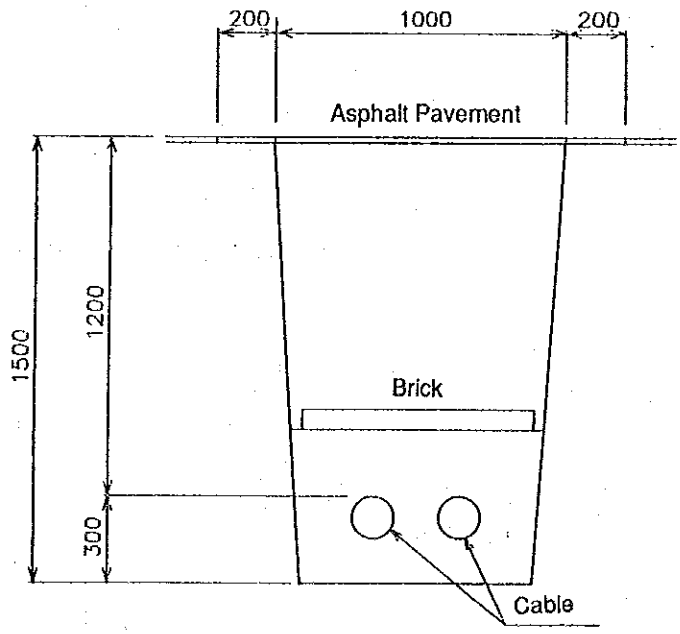
Tension Support Assemblies
(For 20KV Line)

TITLE

Figure II.3.18
INSULATOR ASSEMBLY

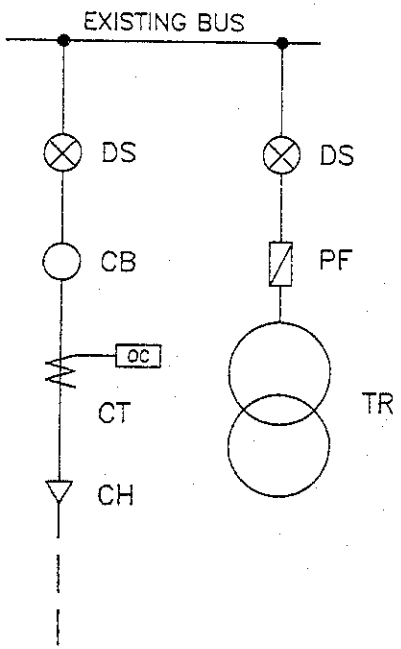


Road Cross Section

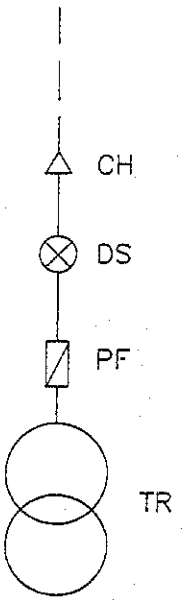


Footpath, General Roads

TITLE Figure II.3.19
UNDERGROUND CABLE LINE,
LONGITUDINAL SECTION



No.127



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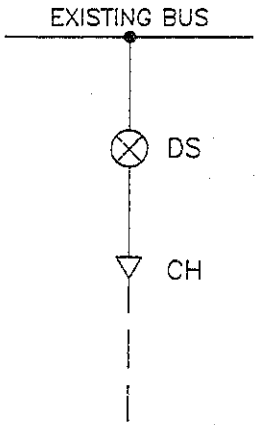

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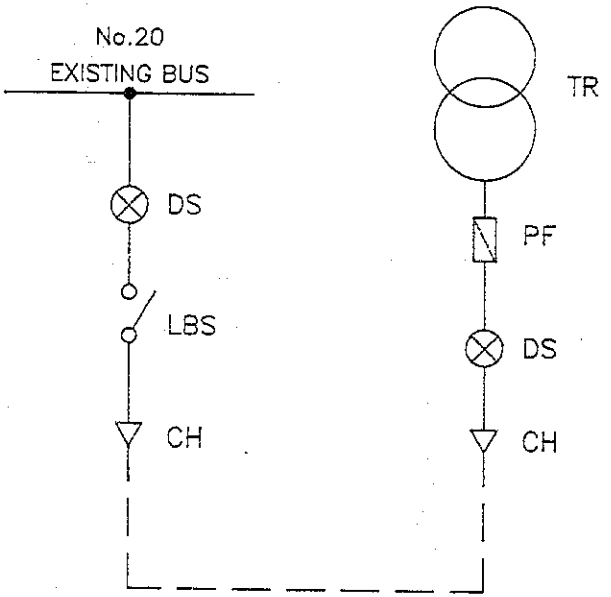
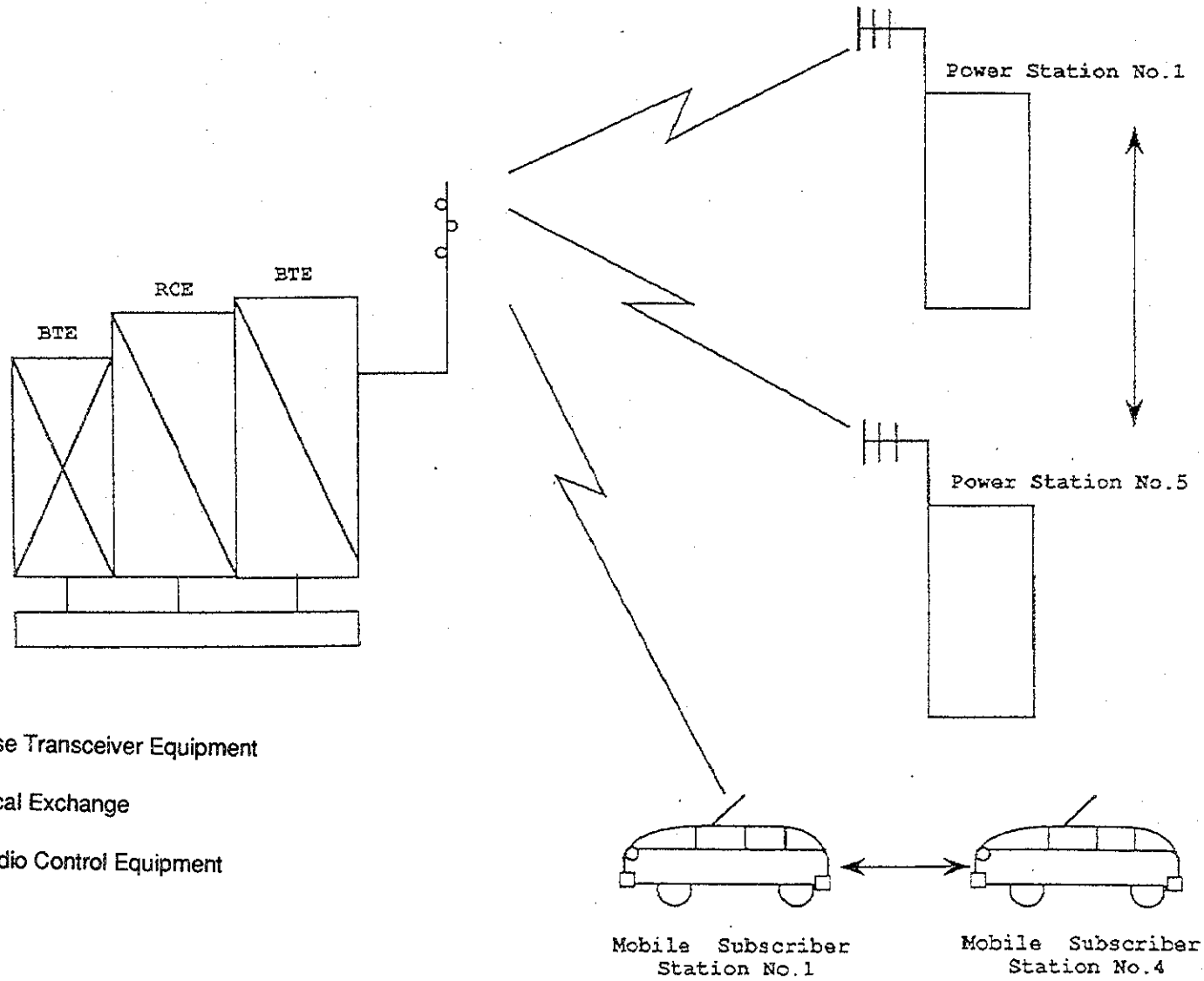


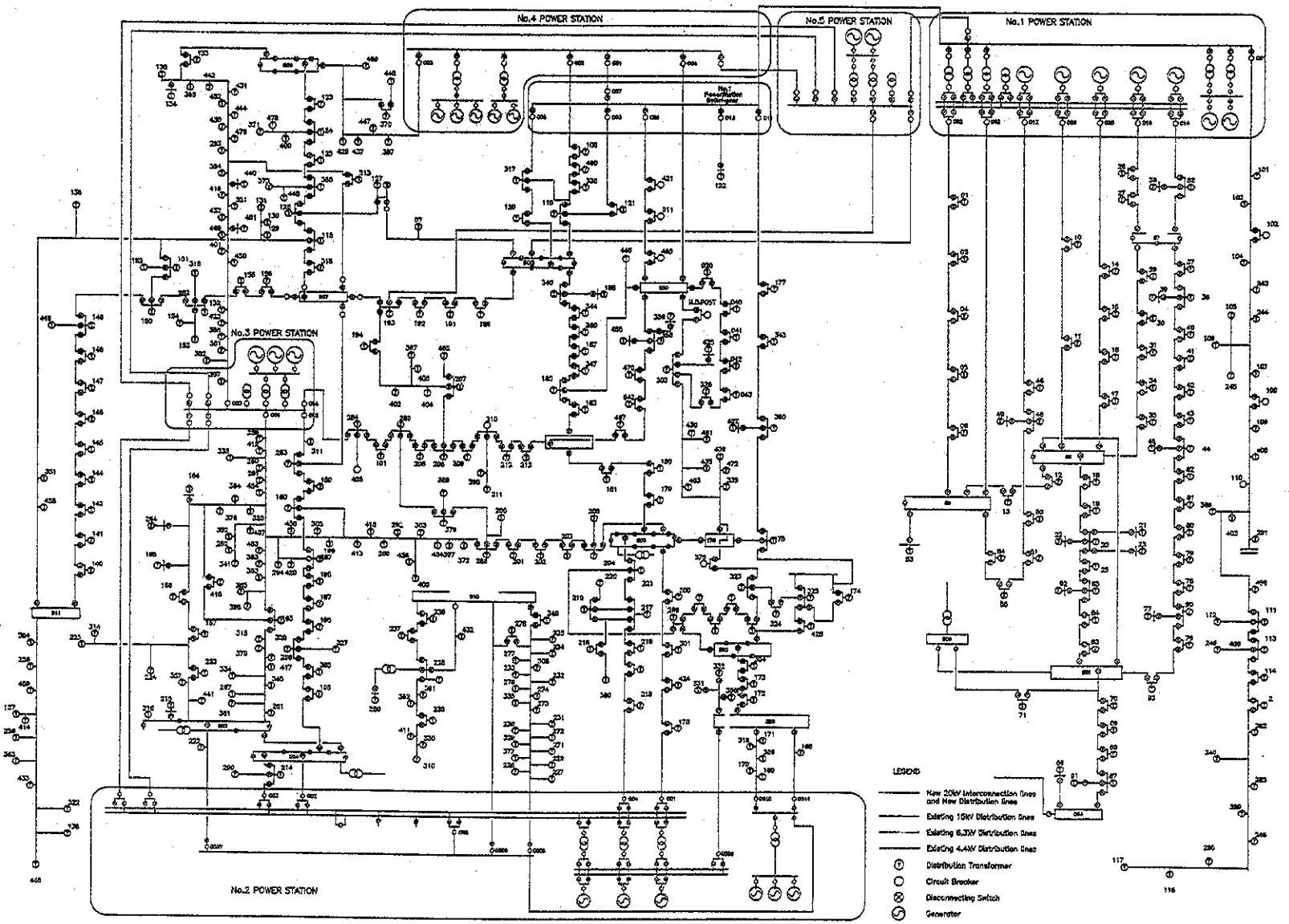
New Distribution Post

TITLE

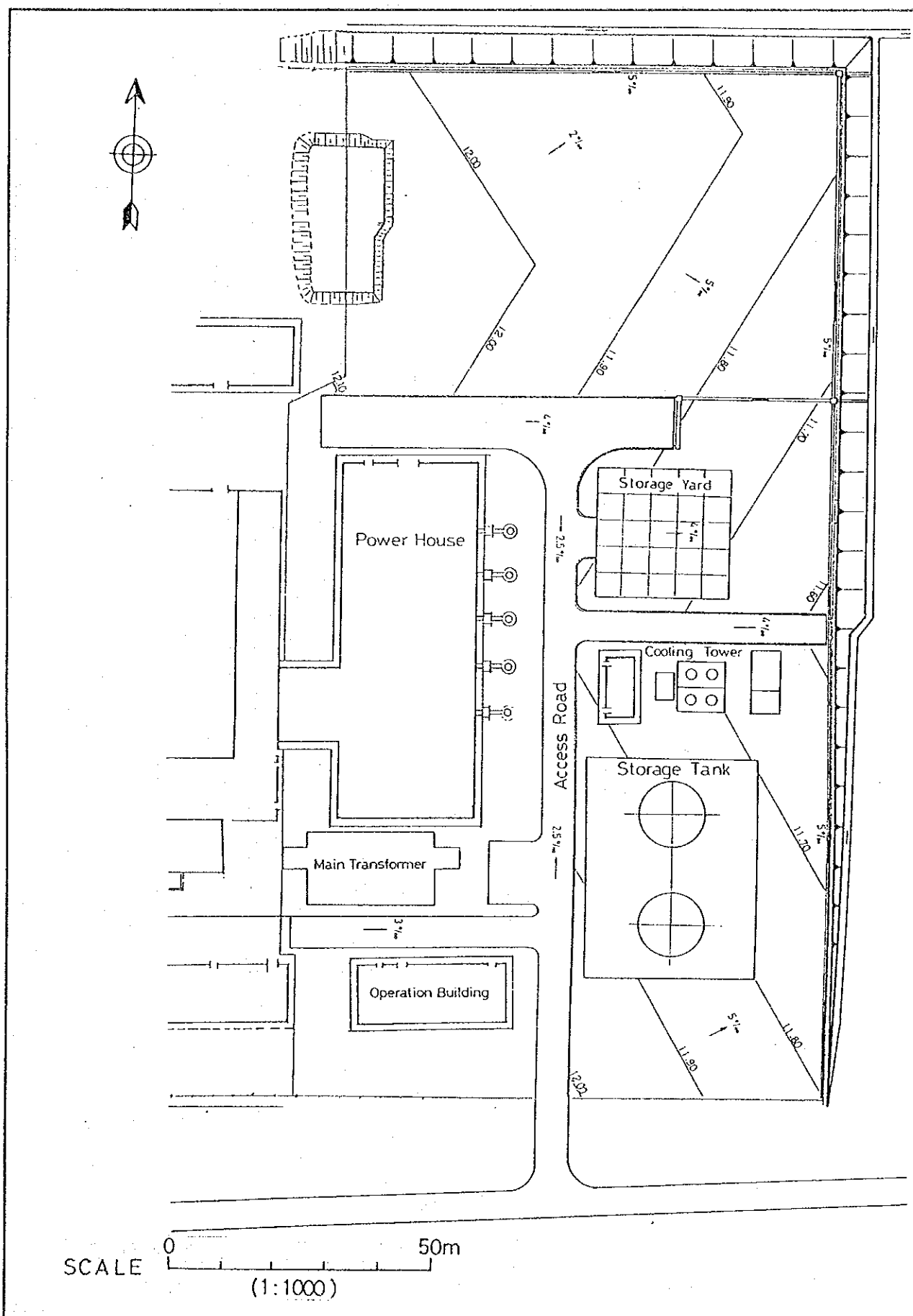
Figure II.3.20
CONNECTION DIAGRAM FOR
DISTRIBUTION STATION



TITLE Figure II.3.21
SYSTEM COMPOSITION DIAGRAM OF TELECOMMUNICATIONS & LDS

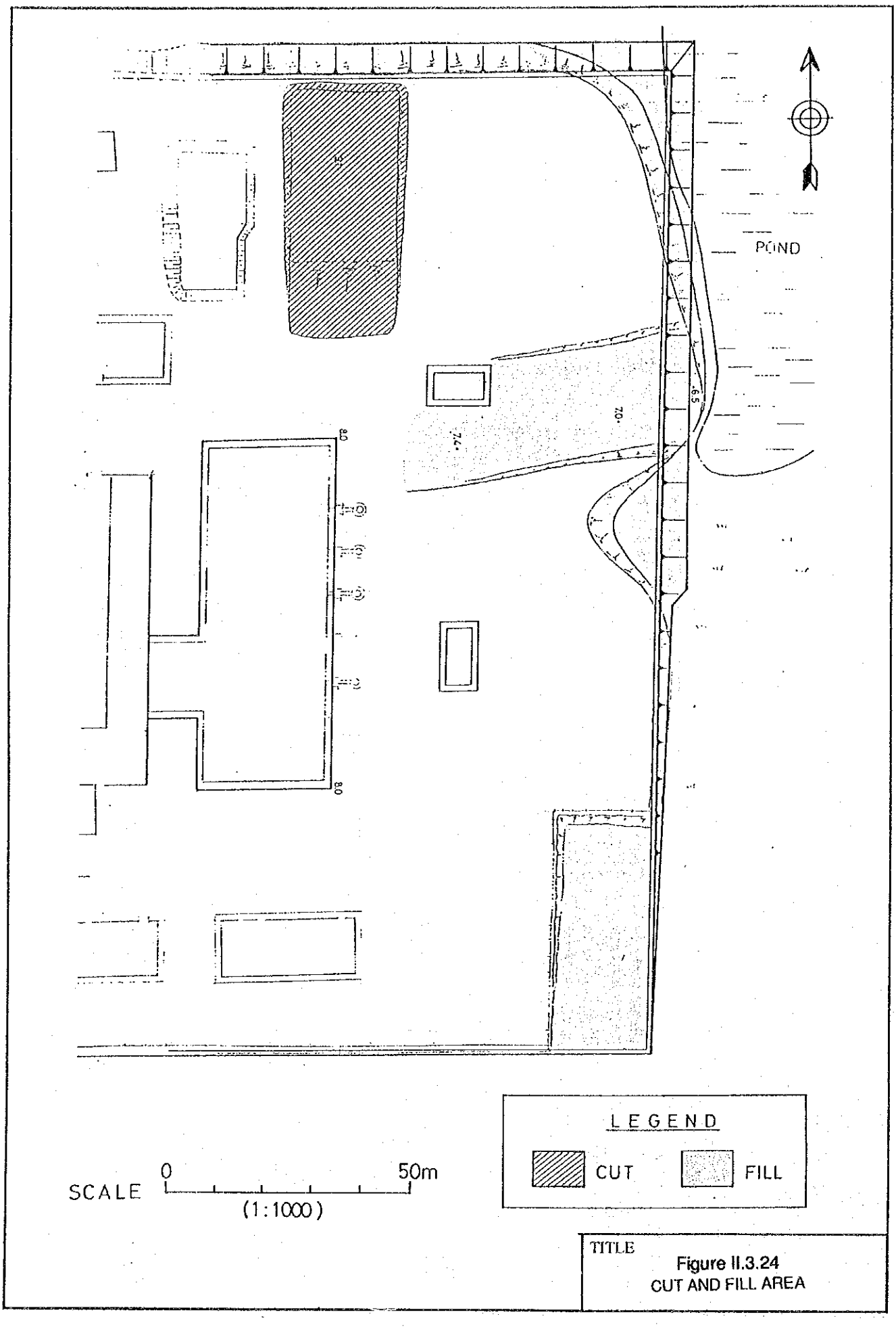


TITLE Figure II.3.22
ARRANGEMENT OF COLLECTIVE SUPERVISORY BOARD



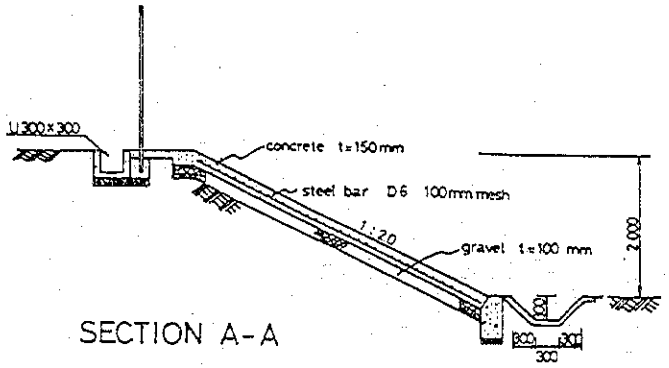
TITLE

Figure II.3.23
SITE PREPARATION

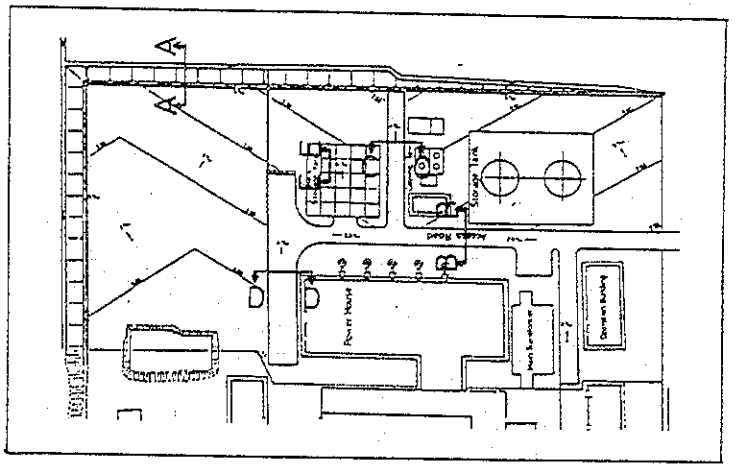


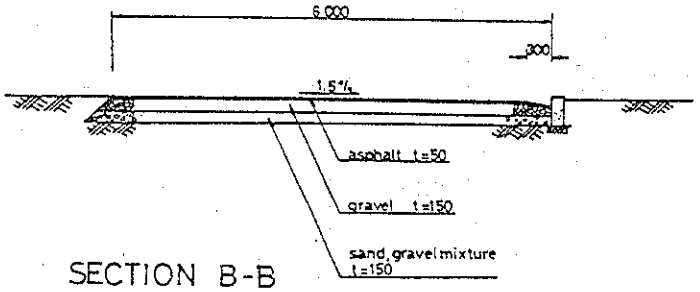
TITLE

Figure II.3.24
CUT AND FILL AREA

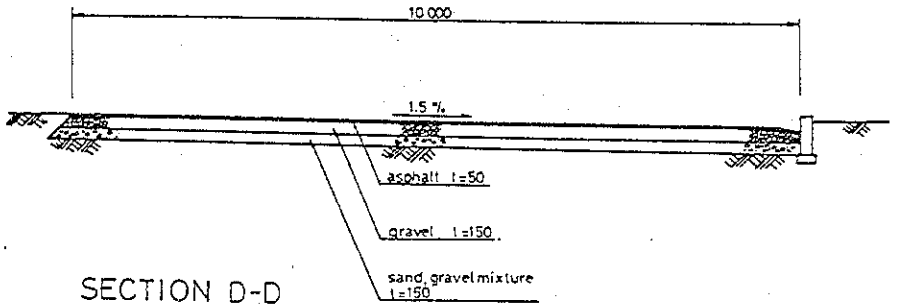


SECTION A-A

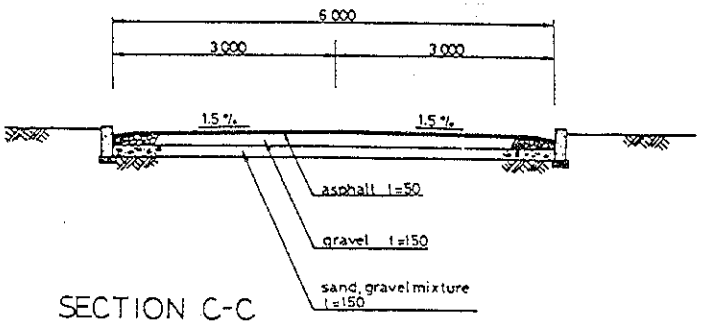




SECTION B-B



SECTION D-D



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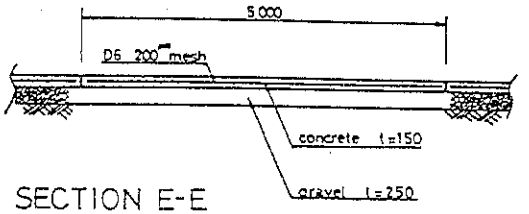
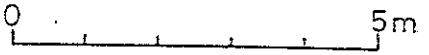


SECTION E-E

SCALE

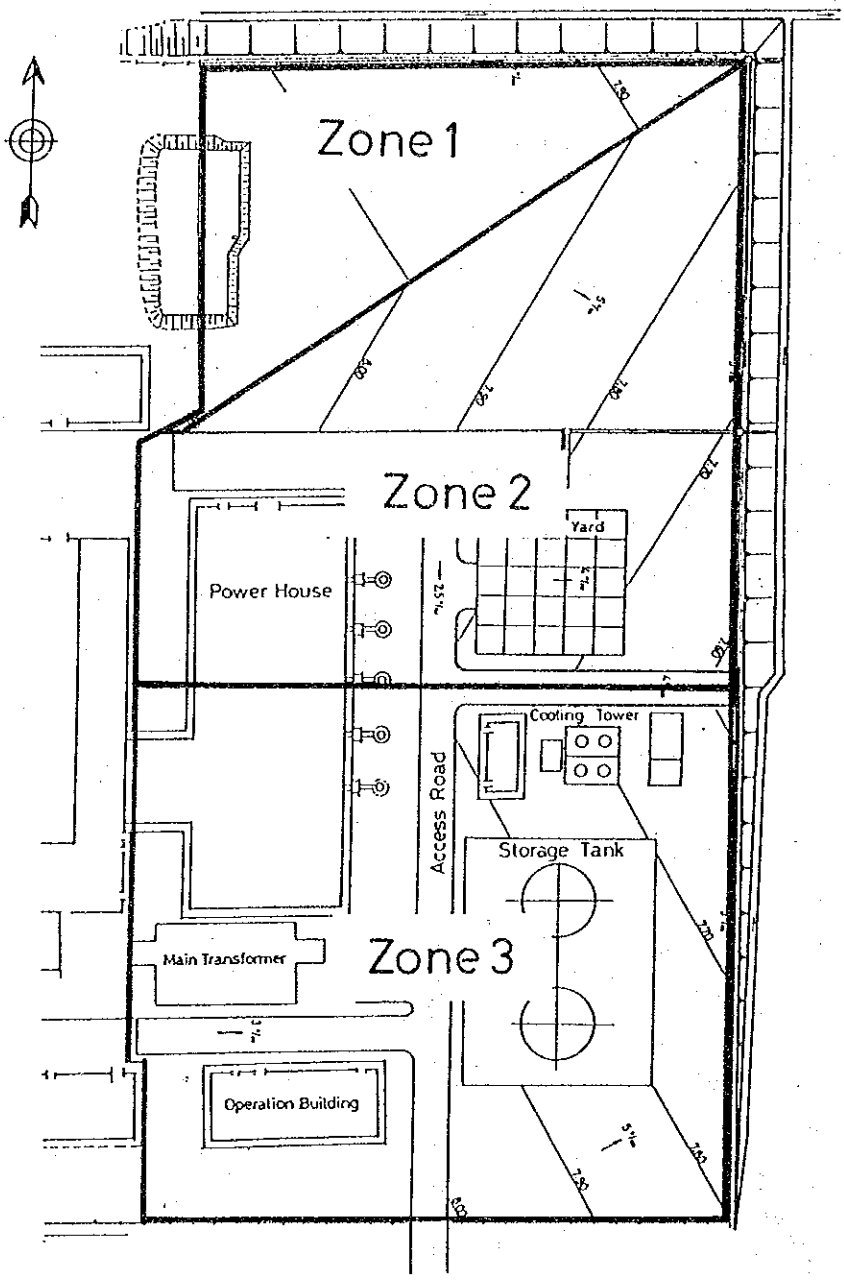


(1 : 100)

TITLE

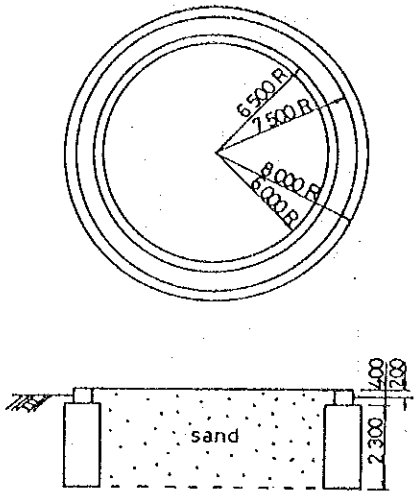
Figure II.3.25

SLOPE PROTECTION AND PAVEMENT

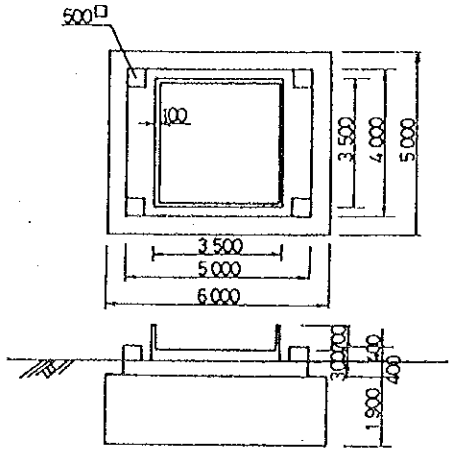


TITLE

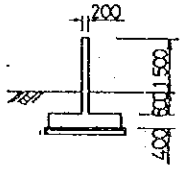
Figure II.3.26
CATCHMENT AREAS



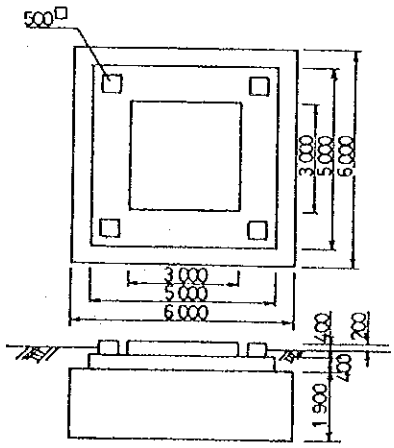
Diesel oil tank



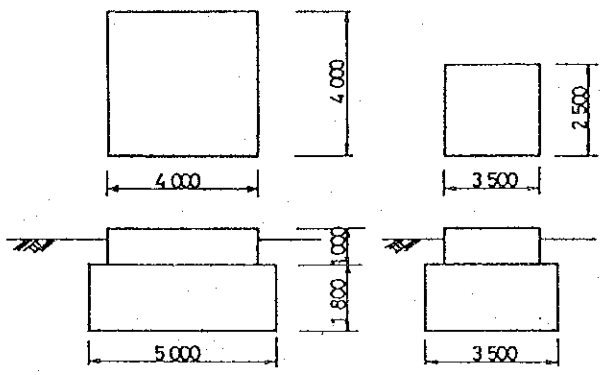
Buffer tank



Oil fence



Silencer

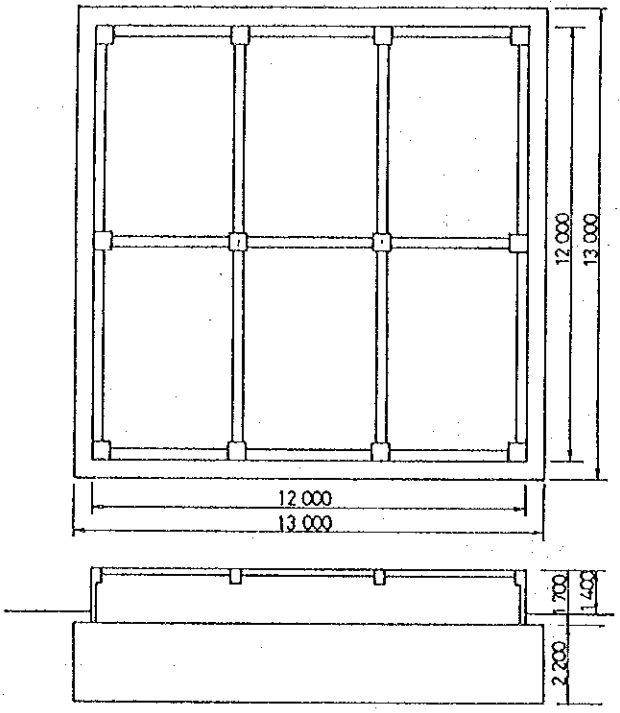


6,300KVA 630KVA

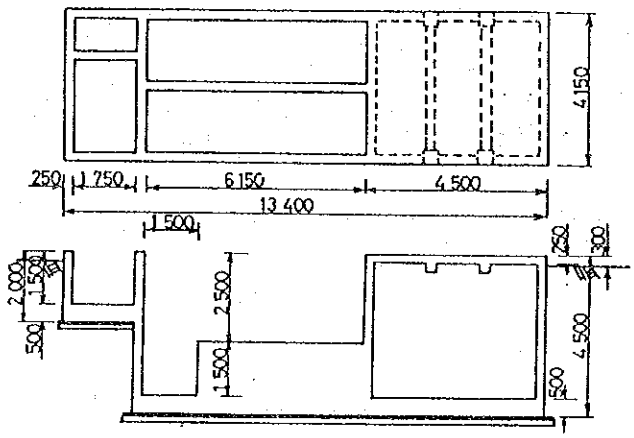
SCALE 0 5m
(1:200)

Transformer

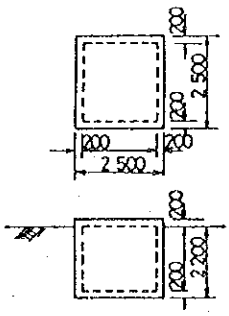
TITLE Figure II.3.27 (1)
FOUNDATION OF
OUTDOOR FACILITIES (1)



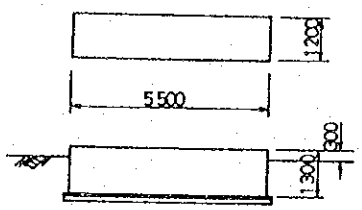
Cooling tower



Precipitator



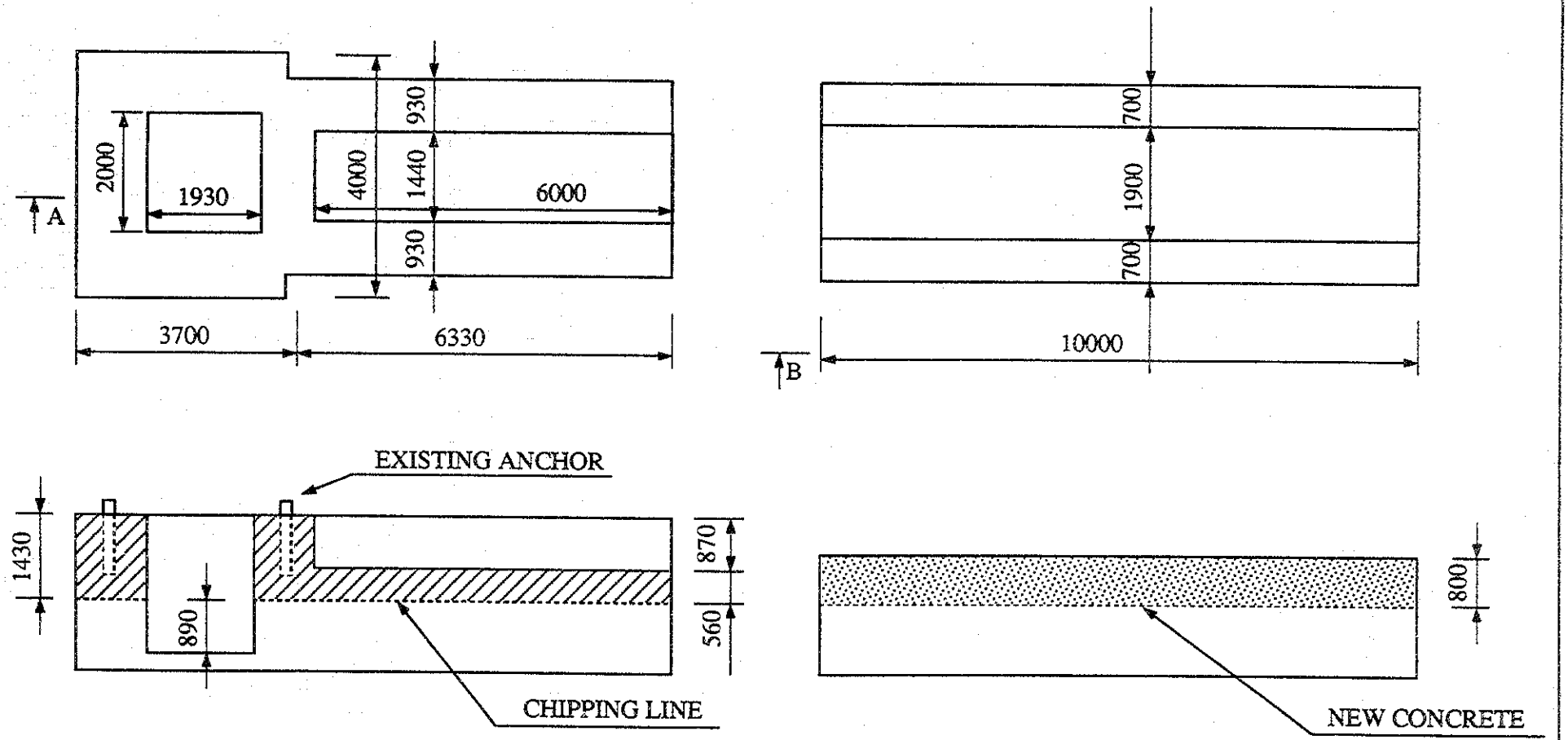
City water tank



Dosing device

SCALE 0 5m
(1:200)

TITLE Figure II.3.27 (2)
FOUNDATION OF
OUTDOOR FACILITIES (2)



VIEW A

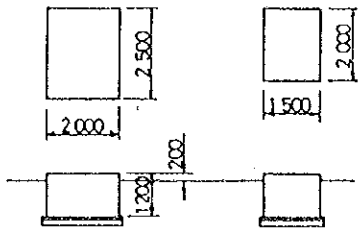
EXISTING FOUNDATION

VIEW B

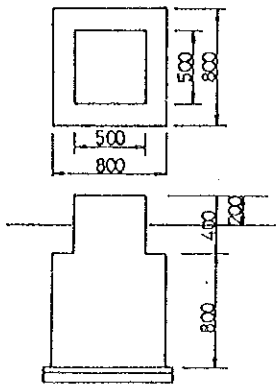
MODIFIED FOUNDATION

TITLE

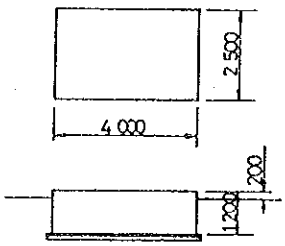
Figure II.3.28
D/G FOUNDATION



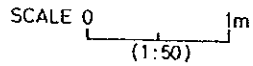
Oil treatment unit

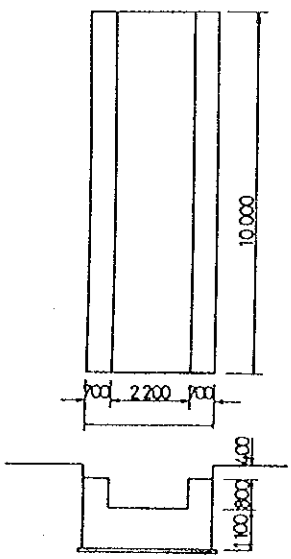


Control unit

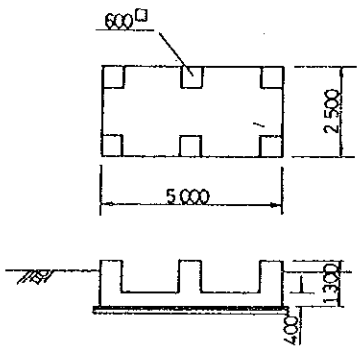


Sluge treatment unit

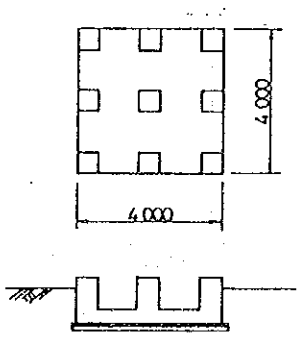




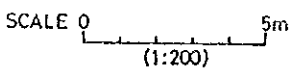
Diesel engine



Auxiliary block A, B



Auxiliary block C



TITLE

Figure II.3.29
FOUNDATION OF INDOOR FACILITIES

Chapter 4

Project Benefits and Conclusions

CHAPTER 4 PROJECT BENEFITS AND CONCLUSIONS

The Project involves the installation of a new diesel engine generator and new distribution lines, the repair of existing distribution lines, and the improvement of telecommunications and power dispatch facilities. This expansion would increase Phnom Penh's present power output by approximately 42%, and would improve the present power situation so that recovery projects are not delayed by a shortage of power. The new power plant would provide a maximum of 84.0 GWh per year, almost 60% of the total power output by EDP in 1992. Execution of the Project would have many important merits: it would not only eliminate the planned blackouts affecting consumers at present but would also meet latent demand and, through supplying stable power, would contribute to regional infrastructure and economic recovery, as well as improving the welfare of the citizenry. It is envisaged that 800,000 people will benefit from the Project.

The new generator will assist in solving a major bottleneck, i.e. the lack of electricity in infrastructure projects which exists at present. Solving this dilemma will once again create a situation conducive to productive employment for returning refugees and demobilized soldiers. This would help increase production, promote private and public investment, restore public services, bring Cambodia's economy into the world economy, and maintain continuous development of Cambodia's private sector, substantially contributing to economic development and social stability.

The Study Team, therefore, has determined that cooperation in the form of grant aid would be appropriate for the Project.

Appendix

MINUTES OF DISCUSSIONS

MASTER PLAN STUDY ON REHABILITATION AND RECONSTRUCTION OF ELECTRICITY SUPPLY IN PHNOM PENH AND SIEM REAP, CAMBODIA

In response to the request of Supreme National Council (SNC), Japan International Cooperation Agency on behalf of the Government of Japan (GOJ) dispatched a study team for the captioned study to Cambodia from January through July 1993. The Team has conducted field survey with collection of information/data, analyzed the information/data and prepared the progress report and interim report under cooperation of the Cambodian counterparts. The Team submitted its Draft Final Report for the study on June 28, 1993 to Electricite du Cambodge (EDC). The report includes Basic Design Level Study for the recommended facilities most effectively to contribute to rehabilitation and reconstruction of the Phnom Penh power system and to be implemented under the assistance of GOJ. The Team explained the master plan and basic design to EDC from June 30 through July 6 1993 in Phnom Penh. EDC agreed to the report.

On April 27, 1993 the former Electricite de Phnom Penh (EDP) changed its name to EDC. However, its new organization was not disclosed during the Team's stay in Cambodia. EDC agreed with the Team that descriptions in the report relating to the organizations and functions of the country's power sector as well as new EDC will remain unchanged due to current indefiniteness on them.

Through the discussion with the Team, EDC verbally asked the Team to convey the following EDC's proposals to GOJ. The Team undertakes to do this conveyance.

(1) request for further assistance in rehabilitation and reconstruction of electricity supply of the provincial power systems.
(2) request to conduct the master plan study of Cambodia's water resources for hydropower development in medium and long term program of energy sector.

Phnom Penh, July 8, 1993

ELECTRICITE DU CAMBODGE

Toeung Chin
Deputy Director of
Electricite du
Cambodge

K. Nakajima

Ko Nakajima
Leader of JICA Study Team for
Rehabilitation and Re-
construction of Electricity
Supply in Phnom Penh and
Siem Reap, Cambodia

MASTER PLAN STUDY
ON
REHABILITATION AND RECONSTRUCTION OF ELECTRICITY SUPPLY
IN PHNOM PENH AND SIEM REAP, CAMBODIA

MINUTES OF DISCUSSION

In response to the request of Supreme National Council (SNC), Japan International Cooperation Agency (JICA) sent to Cambodia a study team for formulating an appropriate rehabilitation and reconstruction plan on the existing power supply system both in Phnom Penh and Siem Reap (hereinafter called the Team), and to conduct the study at a basic design level for the most effective project in Phnom Penh. The team stayed in the country from January 12, 1993 through February 8, 1993.

During the period, the team conducted the collection and analysis of various records and information concerned the study under assistance of counterparts from the Ministry of Industry, Electricite du Phnom Penh and Siem Reap province, held discussions with officials concerned as well as international organizations and achieved field surveys in Phnom Penh and Siem Reap.

In the course of the field study, parties concerned have discussed the preliminary results of the Team's site examination and confirmed with the counterparts the main items for the Basic Design Level Study for the Phnom Penh power system as stated in the attached two Minutes of Discussion with the counterparts. On the basis of the discussions and the confirmation, the Team will proceed to further works for formulating the master plan for both Phnom Penh and Siem Reap cities and the basic design level study for electricity facilities in Phnom Penh. The Team will prepare the Interim Report, the Progress Report, Draft Final Report and Final Report on the basis of the works.

For H.E. Hor Namhong
Member of S.N.C
Coordinator for Economic Cooperation
with Japan

Khlaut Randy
Vice Minister of Ministry of Industry
Cambodia

K. Nakajima

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Leader of JICA Study Team for Rehabilitation and Reconstruction of Electricity Supply in Phnom Penh and Siem Reap

MASTER PLAN STUDY
ON
REHABILITATION AND RECONSTRUCTION OF ELECTRICITY SUPPLY
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MINUTES OF DISCUSSION (1)

1. Place of and Attendance to Discussion

Please refer to Annex-1.

2. Objective of Meeting

The objective of this meeting is to explain results of the master plan study, and discuss and determine the basic design concept for facilities selected by the Team for the most effective measures to rehabilitation and reconstruction of electricity supply in Phnom Penh power system.

3. Selected Sub-projects

The Team selected following facilities as the most effective facilities to be rehabilitated and reconstructed in the Phnom Penh power system under the assistance of the Government of Japan.

(a) No. 5 power station with installation of 2 units of equivalent output capacity of 5MW diesel engine and generator set

The total system peak demand including estimated potential demand which is forecasted by Supreme National Council (S.N.C) is 59.7 to 65.4MW in 1993 and 77.3 to 89.5MW in 1998 as mentioned in the documents for "Request to Japan's Grant Aid" officially submitted to the Government of Japan. The system peak demand forecasted by the Team is 63MW in 1995 and 81MW in 1998 including estimated potential demand and losses in the network.

While, rehabilitation of the existing power facilities and additional installation of new diesel power facilities by various bilateral assistance and international organizations are committed and expected to be realized by the year 1995. Power supply capacity after rehabilitation to the existing generating facilities and addition of new diesel generating sets is estimated by United Nations Development Programme (UNDP) to

increase to 86MW by 1995 including 10MW expected to assistance by the Govèrnment of Japan.

The possible output of 86MW in the system will be sufficient for the total system power demands in both 1995 (61MW) and 1998 (81MW) forecasted by the Team, even if the largest unit of generating facilities in the system is out of operation for the periodical overhaul or inspection.

Upon the official request from S.N.C, the Government of Japan decided to assist the rehabilitation and reconstruction of No.5 power station.

Under such circumstances, the Team's recommendation is therefore under assistance of the Government of Japan to install 2 units of 5MW (effective output) each in the No.5 power station utilizing the existing power house and overhead travelling crane, as a result of economical study on various alternatives.

(b) Interconnection of the existing Northern and Southern Power Systems

For the effective operation and maintenance of the power system, it is recommended to establish the interconnection line of the northern and southern systems as requested by S.N.C. Interconnection of the systems will be achieved by means of new overhead lines for connecting all the existing power stations. The lines will be operated in 15kV on 20kV design taking account of the future system voltage.

In addition to the interconnecting line, other lines will also be recommended to be provided for effective operation of the No.5 power station and the existing power system.

(c) Centralized System Control

New VHF radio equipment is recommended to be installed at five (5) power stations and several mobile stations for the effective operation of the power stations and proper maintenance of the power network. All those radio communications will be centralized to EDP's (Electricite de Phnom Penh) control center located at the EDP's head office. A mimic panel (synoptic lighting board) will be installed in the load dispatching center.

4. Responsible Organizations

When the implementation of the project under grant aid is approved, following

organizations of S,N.C will be assigned for the project execution.

(a) Responsible Ministry : Ministry of Industry (MOI)
(b) Responsible Authority : Municipality of Phnom Penh
(c) Implementing Agency : Electricite de Phnom Penh (EDP)

5. Japan's Grant Aid System

The Ministry of Industry and EDP have understood the structure and system of Japan's grant aid.

6. Basic Design Concept

The basic design level study will be achieved in Japan on the facilities in Phnom Penh power system as selected in the above (3).
The study will be conducted on the basis of the following condition and concept, but it is to be noted that the concept is subject to modification due to the results of further studies in Japan.

(6-1) No.5 Power Station

(a) New machines will be installed in the existing building.
(b) Total capacity to be set in the power station will be 2 x 5MW.
(c) EDP is responsible for dismantling of all the existing facilities in No.5 power station and removal of the dismantled machines, equipment and materials to the EDP's Warehouse for storing prior to commencement of the construction of new machines at expense of S.N.C.
The officials explained serious shortage of fund for works of dismantling and storing of the existing facilities and requested the Team to convey to the Government of Japan so that this work will be done under assistance of the Japan's Grant Aid Programme.
(d) Additional facilities such as a cooling water pond, water piping from the Tonle Sap river, etc. will be provided under the Japan's Grant Aid Programme.
(e) Other design conditions are summarized in Annex-2.

(6-2) 15kV Line

(a) The northern and southern power systems in Phnom Penh will be interconnected for stable power supply in the network.

(b) The interconnection line will be on the overhead line along the route selected by the team and agreed by EDP.

(c) Other 15kV lines effected for improvement of the stable power supply are also selected and will be designed for implementation.

(d) Design conditions are summarized in Annex-2.

(6-3) Centralized System Control

(a) All power stations will be connected each other and with the control center in EDP's head office by means of VHF communications system.

(b) A mimic panel will be provided at the load dispatching center in the EDP's head office displaying the situation of the network with lamps and manual switches. It will be not an automatic display board, but manually operated. Therefore, no cable among each power station/substation and the dispatching center connects for the data transmission.

(b) Design conditions are summarized in Annex-2.

The officials agreed that (a) the sub-projects selected and studied for the Basic Design Level Study are not final for implementation under assistance of the Government of Japan, (b) the components of the Project will be recommended after further studies, and (c) the concrete sub-projects to be implemented will be stipulated in the Progress Report.

7. Undertaking by Supreme National Council

Responsible authorities of S.N.C for the project shall undertake items listed in Annex-3 when the Government of Japan decides to extend grant aid for the said project.

8. Schedule of Study Team

The Team will continue the following works in Cambodia and Japan for formulating the master plan and preparing of the basic design level study report.

(a) The basic design level study team will leave for Japan on January 29, 1993.

(b) The master plan study team will be in Siem Reap from January 30 to February 4 to investigate its power system .

(c) Interim report for the study will be submitted with 20 copies to the Ministry of Industry before leaving Cambodia of the master plan study team.

(d) The master plan study team will leave for Japan on February 8, 1993.

(e) Five (5) members of the team will visit Cambodia with Government officials of Japan

at the end of March, 1993, and submit and explain the Progress Report of the study.

(f) Four (4) members of the team will visit Cambodia the end of June, 1993 for submitting and explaining the draft Final Report to the Ministry of Industry.

(g) The team will further continue the study in Japan by the end of July, 1993.

(h) Final Report reflecting comments on the draft final report from MOI and EDP will be submitted to JICA Tokyo by the end of July, 1993.

9. Training Programme in Japan

The Team conveyed to the Ministry of Industry and EDP the training schedule of JICA head office. Two (2) persons for a period of about 20 days each will be trained in Japan during May 1993. JICA requested S.N.C to submit the application forms of two persons to the Team to visit Cambodia in March 1993.

Mayor of Phnom Penh Municipality	Toeung Chin Director of Electricite de Phnom Penh	Ko Nakajima Leader of JICA Study Team for Rehabilitation and Reconstruction of Electricity Supply in Phnom Penh and Siem Reap

SIM KA

Mayor of

Phnom penh municipality

ANNEX - 1

ATTENDANCE TO MEETING

Date of Meeting	: January 26, 1993
Place of Meeting	: Conference room of EDP's Head Office

Attendance

Ministry of Industry	: Mr. Nhek Chroeung (Director of Energy Department)
Electricite de Phnom Penh	: Mr. Toeung Chin (Director)
	Mr. Men Sarun (Deputy Director)
	Mr. Ty Norin (Head Office of Electricity Network)
	Mr. Ros Chenda (Director of No.4 Power Station)
	Mr.Sieng Ky Hong (Deputy Chief of Planning)
JICA Study Team	: Mr. Ko Nakajima (Team Leader)
	Mr. Mitsuto Tsutsui (Generation Planning)
	Mr. Yoshitomo Watanabe (Electrical Design)
	Dr. Satoshi Minoyama (Mechanical Design)
	Mr. Toshiyuki Arita (System Planning)
	Mr. Tadashi Nio (Electrical Equipment)
	Mr. Takashi Fukagai (Mechanical Equipment)

ANNEX - 2

DESIGN CONCEPT AND CRITERIA

1. General			
(1) Applied Standards	:	IEC, JIS, JEC, JEM, JCS, BS and other internationally recognized standards	
(2) Basic Insulation Level	:	20 kV system for interconnection	125 kV
		15 kV system	95 kV
		6 kV system for generator	60 kV
2. Generating Plant			
(1) Fuel Oil	:	Diesel oil (equivalent to JIS K 2204-2)	(*1)
(2) Frequency	:		50 Hz
(3) Type of Engine	:	Single action diesel engine	≤ 750 RPM
(4) Regulation of	:	Speed	± 5 %
	:	Voltage	± 2 %
(5) Standard Voltage	:	Low tension : 400/230 V ± 10 %	
3. Distribution Line			
(1) Wind Velocity	:	Maximum velocity in Phnom Penh	25 m/s
(2) Air Temperature	:	Maximum	41 °C
	:	Average	27 °C
	:	Minimum	13 °C
(3) Minimum Safety Factors	:	Support under normal condition	2.0
	:	Support under broken-wire condition	1.1
	:	Conductor	2.5
	:	Insulator (mechanical)	3.0
	:	Foundation of supports under normal	2.5
	:	Foundation of supports under broken-wire condition	1.25
(4) Minimum Conductor Clearances	:	20kV at road crossing - above ground	7.5 m
	:	20kV on other terrain - above ground	7.0 m
	:	LT line at road crossing - above ground	6.0 m
	:	LT line along road - above ground	6.0 m
	:	LT line on other terrain - above ground	5.0 m
(5) Minimum Depth of Underground Cable	:	Under major road	1.2 m
	:	Under other terrain	0.6 m

4. Telecommunications and Load Dispatching Systems

(1)	Frequency	: 400 Mhz band	
(2)	Number of channel	:	10

5. Civil and Building Works

(1)	Minimum Safety Factor	: Foundations of facilities	3.0
(2)	Strength of Concrete	: Ultimate design strength	210 kg/cm^2
(3)	Rain Fall Intensity	:	
(4)	Seismic Load	: not applied	
(5)	Embankment	: Approximate gradient	1 : 2

6. Utilization of Existing Facilities in No.5 Power Station

(1)	Diesel Engines	: not used but to be removed for No.4 power station
(2)	Generators	: not used but to be removed for No.4 power station
(3)	Auxiliary Equipment for Engines	: not used but to be removed for No.4 power station
(4)	Auxiliary Equipment for Generators	: not used but to be removed for No.4 power station
(5)	Control & Protection Equipment	: not used but to be removed for No.4 power station
(6)	Miscellaneous Materials	: not used but to be removed for No.4 power station
(7)	Overhead Travelling Crane (16 tons)	: utilized
(8)	Fuel Storage Tank	: not utilized due to incomplete tank and corrosion of materials
(9)	Cooling Water Pond	: not existed
(10)	Piping System for Engines	: not used due to incomplete system and corrosion of materials
(11)	Switchboards	: not provided
(12)	Power House/Control Room/Office	: utilized but partial reconstruction required
(13)	Foundations	: utilized but partial reconstruction required
(14)	Main Transformers	: not used due to deterioration

Note: (*1) Further examination will be conducted by the Team for common use of diesel oil and heavy oil for fuel for engines.

ANNEX - 3

UNDERTAKING OF SUPREME NATIONAL COUNCIL

Following are to be undertaken by Supreme National Council (S.N.C), the Municipality of Phnom Penh and Electricite de Phnom Penh as the implementing agency, when the Government of Japan decides to extend grant aid for the project for Rehabilitation and Reconstruction of Electricity Supply in Phnom Penh.

(A) For Detailed Design Stage

1. To provide the team with all data and information required for the design.
2. To secure the safety of the team.
3. To permit the members to enter, leave and sojourn in Cambodia for the duration of the team's assignment therein, and exempt them from alien registration requirements and consular fees.
4. To exempt the members of the team from taxes, duties and other charge on equipment, machineries and other materials brought into or taken out of Cambodia for the conduct of the work.
5. To exempt the members of the team from income tax and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the team for their services in connection with the work.
6. To provide the necessary facilities to the team for remittance as well as utilization of the funds introduced into Cambodia from Japan in connection with the implementation of the work.
7. To secure permission for entry into private properties or restricted areas for conduct of the work.
8. To secure permission to take all data and documents (including photographs and maps) related to the work out of Cambodia to Japan by the team.
9. To provide medical services as needed. Its expenses will be chargeable on the members of the team.
10. To assign the necessary counterpart experts working in Phnom Penh at the expense of

Cambodia for the duration of assignment of the relative member of the team.

11. To provide necessary vehicles with drivers, fuel and spare parts for the Cambodian counterpart experts working in Phnom Penh at the expenses of Cambodia during their assignment.

(B) For Implementation of Project

1. To bear the following commission to the Japanese foreign exchange bank for the banking service on the basis of the Banking Arrangements:

   (a) Advising commission of Authorization to Pay
   (b) Payment commission

2. To obtain necessary permits for import of equipment and materials into Cambodia and to bear the license fee for such permits. (Manifest of those equipment and materials should be submitted to the Cambodian authorities in 2-3 weeks before arrival of those equipment and materials.)

3. To permit Japanese nationals whose services may be required in connection with the supply of the products and the services under the contract, such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their works.

4. To exempt Japanese nationals for the project from customs duties, internal taxes and other fiscal levies which may be imposed in Cambodia with respect to the supply of the products and services under the contract.

5. To bear all the expenses other than those covered by the grant aid necessary for construction of the facilities. (Cambodian workers employed by a Japanese contractor should be paid by the contractor.)

6. To acquire land required to accomplish the project and to obtain the right of construction of all facilities under the project in advance of the commencement of the project.

7. To obtain permission from authorities concerned for construction of underground cables and overhead lines along the routes selected by the Team.

8. To operate and maintain properly and effectively the facilities and equipment

constructed under the project, and to secure stable supply of fuel and lubricating oil to the power station.

9. To inform purpose of the project to people in the project area and to request their cooperation to the project in advance of the commencement of the project.

10. To coordinate with the inhabitants living in the project area on matters which may arise during the implementation of the project.

11. To take power shutdown required for implementation of the project.

12. To secure safety of Japanese nationals for the project.

13. To obtain right of water use from the Tonle Sap river for cooling the engines.

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MINUTES OF DISCUSSION (2)

Subject of Meeting	: Master Plan Study on Rehabilitation and Reconstruction of Electricity Supply in Siem Reap City
Place of Meeting	: Room of Director of Energy Department of Ministry of Industry
Date of Meeting	: February 6, 1993
Attendance	
Ministry of Industry	: Nhek Chroeung (Director of Energy Department)
	: Tun Lean (Deputy Chief Office of General Administration)
	: Ouch Thong Seng (Deputy Chief Development Office)
JICA Study Team	: Ko Nakajima (Team Leader)
	: Mitsuto Tsutsui (Generation Planning)

The Team visited Siem Reap city from January 30, 1993 to February 3, 1993 and discussed on the present situation of the city with following officials of People's Committee of Siem Reap.

Mr. Leng Vy	: Vice President of the People's Committee of Siem Reap Province
Mr. Saot Pisak	: President of Provincial Planning and Investment Office
Mr. Ke Chhan	: Chief of Industrial Department of Province

During the visiting period, the Team investigated the power facilities operated in the city as well as the old diesel power plant. Following are major finding of the Team and results of the Team's preliminary examination on the existing power system in the town.

(1) Collection of Information:

Necessary information for the master plan study was collected by the Team's member under cooperation of the provincial officials.

(2) Power demand:

Rapid growth of power demand is recorded in the recent years due to demand of newly constructed hotels for increasing tourists and supply to UNTAC camps. The Team will analyse the collected record and examine the development of infrastructures and tourism industry for preparing power demand forecast. The forecast will be used as a basis of formulation of the master plan of the Team.

(3) Organization of Power Sector:

All necessary information was collected from the industrial department. The Team

will examine the information in detail and prepare a recommendation to improve the present organization to suit for the expanding power system.

(4) Generating Facilities:

It is admirable that the existing generating facilities are well operated and maintained under the serious shortage of spare parts. However, no concrete development programme for additional installation and no supply of sufficient spare parts will obviously cause more frequent system shutdown and accelerate rapid deterioration of the generating facilities. Since supply of genuine spare parts will not be expected, addition of new generating facilities is strongly required.

(5) Distribution Facilities:

Some portions of the previous distribution facilities have been demolished and deteriorated. Similarly to the generating facilities, upgrade of the existing distribution facilities and extension of the system should be programmed and realized for the regional development including promotion of the tourism.

Detailed analysis on the existing power facilities will further be continued by the Team in Japan and the master plan on rehabilitation and reconstruction of electricity supply in the city will be formulated on the basis of the analysis. Those study will be discussed in the progress report and final report to be prepared by the Team in the following schedule.

(a) Progress Report : submitted to the Ministry of Industry by the end of March 1993.
(b) Draft Final Report : submitted to the Ministry of Industry by the end of June 1993.
(c) Final Report : submitted to JICA Tokyo by the end of July 1993 and then delivered to the Ministry of Industry.

The Team will sibmit the Interim Reprt to the Ministry of Industry on February 8, 1993.

Nhek Chrocung
Director of Energy Department
Ministry of Industry
Cambodia

Ko Nakajima
Team Leder of JICA Study Team for
Rehabilitation and Reconstruction of
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