THE ISLAMIC REPUBLIC OF PAKISTAN

DETAILED DESIGN STUDY
ON
WEST WHARF
THERMAL POWER PLANT PROJECT

FINAL REPORT
SUMMARY

JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Islamic Republic of Pakistan, the Japanese Government decided to conduct a survey on the Detailed Design Study on the West Wharf Thermal Power Plant Project and entrusted the survey to the Japan International Cooperation Agency (JICA).

The JICA sent to Pakistan a survey team headed by Mr. Akio Oiwa, Tokyo Electric Power Services Co., Ltd., from December 1988 to December 1989.

The team exchanged views with the officials concerned of the Government of the Islamic Republic of Pakistan and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

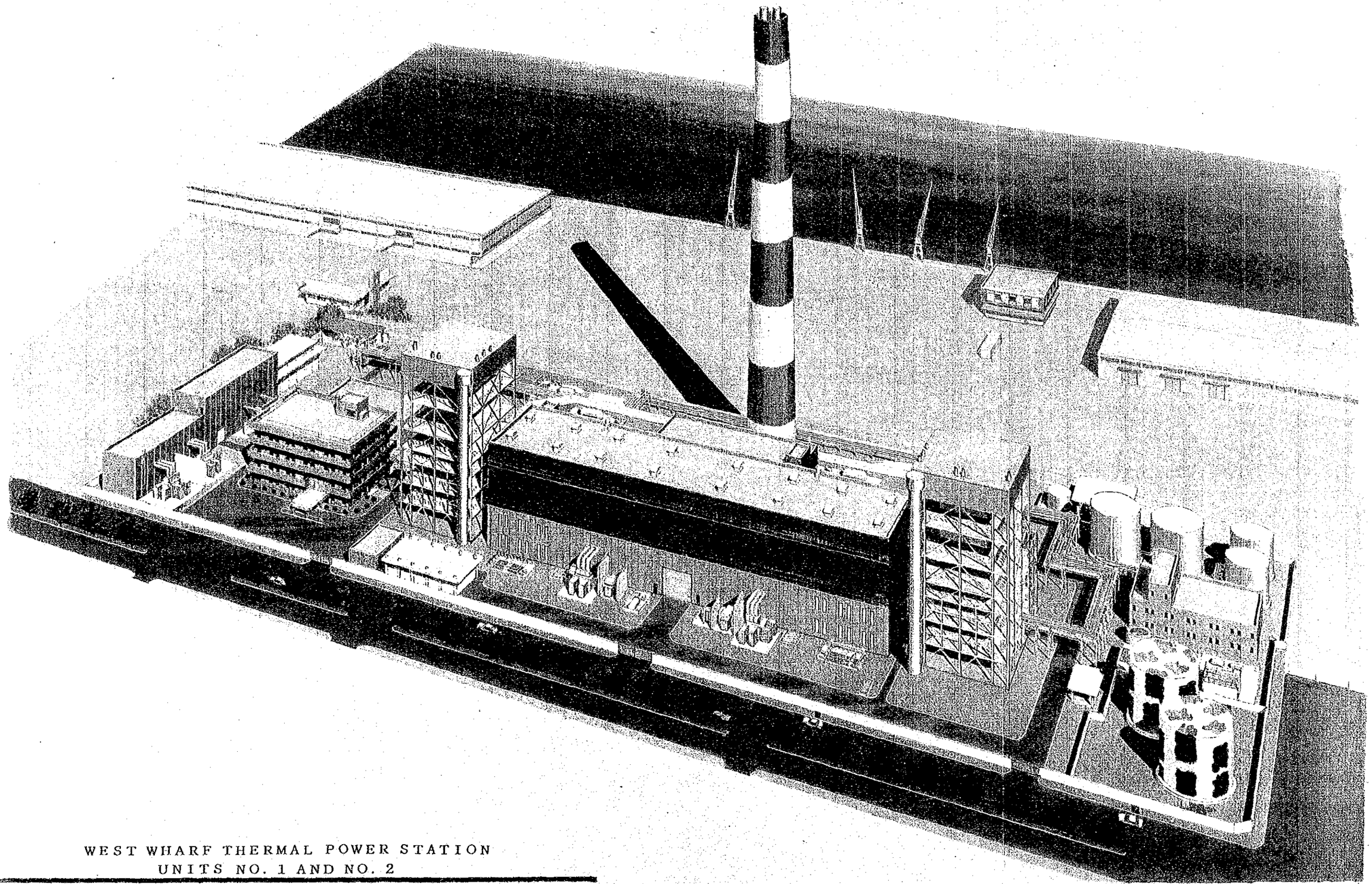
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the team.

January, 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency



WEST WHARF THERMAL POWER STATION
UNITS NO. 1 AND NO. 2

PROJECT SUMMARY

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1. INTRODUCTION

1.1 Introduction of the Report

This Report was prepared based upon the Detailed Design Study Agreement for the West Wharf Thermal Power Plant Project, agreed upon between the Karachi Electric Supply Corporation Ltd. (KESC) and the Japan International Cooperation Agency (JICA).

The Detailed Design Study aims at preparation of the detailed design report and the tender documents to make possible international procurement of power plant facilities and construction of the West Wharf Thermal Power Plant Project, which envisages two sets of 200 MW oil-fired thermal power generating units and related 220 kV transmission and substation facilities.

The report consists of two (2) parts, one is the detailed design report (Final Report-I) and the Other is Tender Documents (Final Report-II). The detailed design study and preparation of the tender documents constitute one stage of the engineering services, and follow the Feasibility Study completed by JICA in May, 1988.

The Detailed Design Report (Final Report-I) describes the technical background of those items which were studied and decided upon in the basic plan of the study, further detailing the plans and designs.

The report consists of engineering study reports and calculation sheets related to the detailed design of the Project.

Each engineering item was selected based upon its relationship to the engineering study item to be concluded within each topic.

The Detailed Design Report constitutes the accumulated design results of the West Wharf Thermal Power Plant, and will be used for understanding why and how the design requirements and specifications were derived at and decided upon.

Should any unsatisfactory or ambiguous items be found at the time of the implementation stage of the project, the original intentions of KESC and the consultant (JICA) will be referred to accordingly.

The report consist of the following three volumes.

Volume 1 General and Power Plant
Volume 2 Transmission Line and Grid Station
Volume 3 Architectural and Civil Work

As the tender documents (Final Report-II) are divided into four (4) lots in accordance with the wishes of KESC, the Technical Specifications were prepared by carefully selecting the "Scope of Supply" items of each lot, uninterrupted construction work with no omissions, etc.

This carefully prepared Scope of Supply will ensure smooth and effective construction work by each constructor without any unforeseen difficulties.

To clarify each tenderer's proposal, the "Form of Technical Data Sheets", stating the contents of the Technical Specifications, was prepared so as to be filled out by the respective tenderers at the time of tender bidding.

Tender documents have been compiled and contain the Technical Specifications, General Conditions, Instruction to Tenderer, schedule of Price etc.

As the General Conditions and Instructions to Tenderers constitute the main portion of the tender documents, these were prepared carefully so as to reflect KESC standards, practices, etc., based on full consultation with KESC.

Tendering will be divided into four (4) tender lots as described below.

Lot I: Power plant facilities

Supply, erection and commissioning of boiler, turbine, generator, electrical control and measurement devices complete with accessories, and architectural/civil work.

Lot IIA: Supply, erection and commissioning of 220/132kV substation at the West Wharf Thermal Power Station area, extension of the Baldia Grid Station, and related architectural civil works including underground cable tunnel with all necessary facilities.

Lot IIB: Transmission line(s)

Material supply, erection and commissioning of transmission line(s) including related civil work.

Lot III: Dismantling work

Dismantling work of "A", "B" and "BX" Stations.

Detailed compilation for each part, with identification numbers, is attached at the end of this report.

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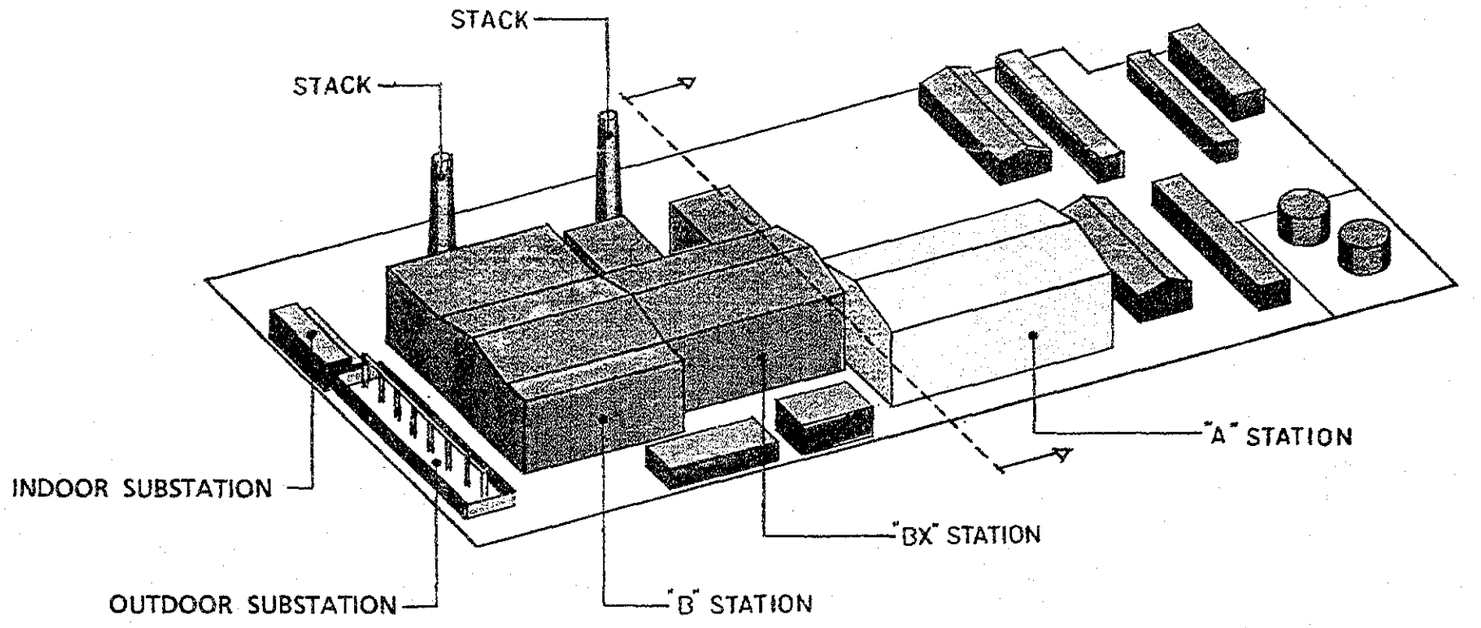
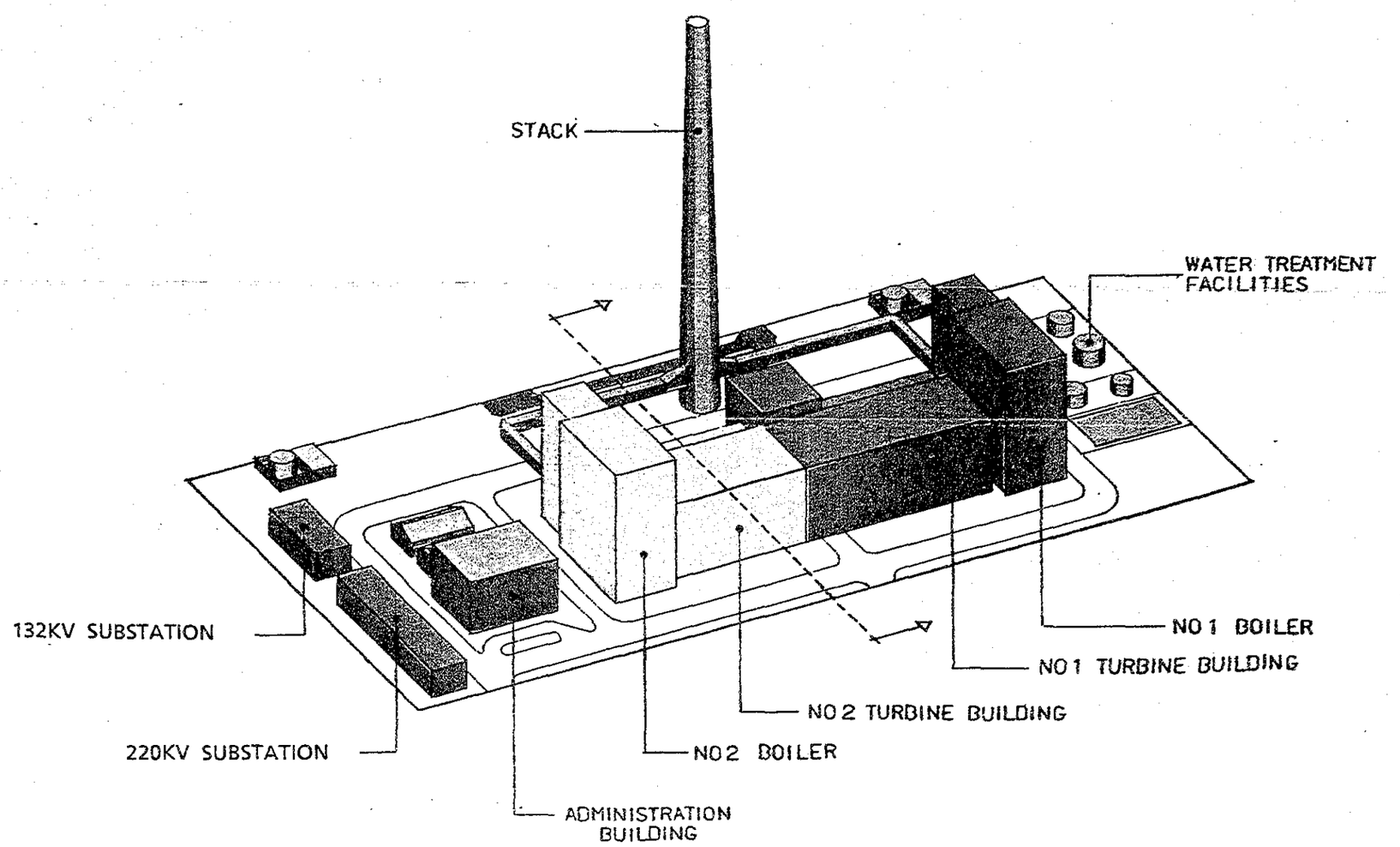
KESC WEST WHARF THERMAL POWER PLANT

EXISTING POWER PLANT



DEVELOPMENT PLAN
2×200MW OIL FIRED THERMAL POWER UNITS



2. OUTLINE OF THE PROJECT

2.1 Power Plant Facilities

Two (2) 200 MW oil-fired thermal power generating units, with auxiliary equipment and other power station facilities including office building, etc., will be constructed at the site of the existing West Wharf Thermal Power Plant with decommissioning and dismantling of the existing facilities. (Refer to attached drawing).

The existing cooling water intake channels within the premises of the Karachi Port Trust will be utilized. Also, discharge channels will be constructed within the premises of the Karachi Shipyard, crossing a public road in the West Wharf area.

Fuel storage facilities constitute reusing the 2,500 kℓ PSO (Pakistan State Oil) tanks. Modifications, such as new fuel receiving and supply piping, transfer system and firefighting system, etc., will be carried out.

(1) Power plant specifications

i) Plant specifications

200 MW oil-fired,
thermal power generating unit: Two (2) sets

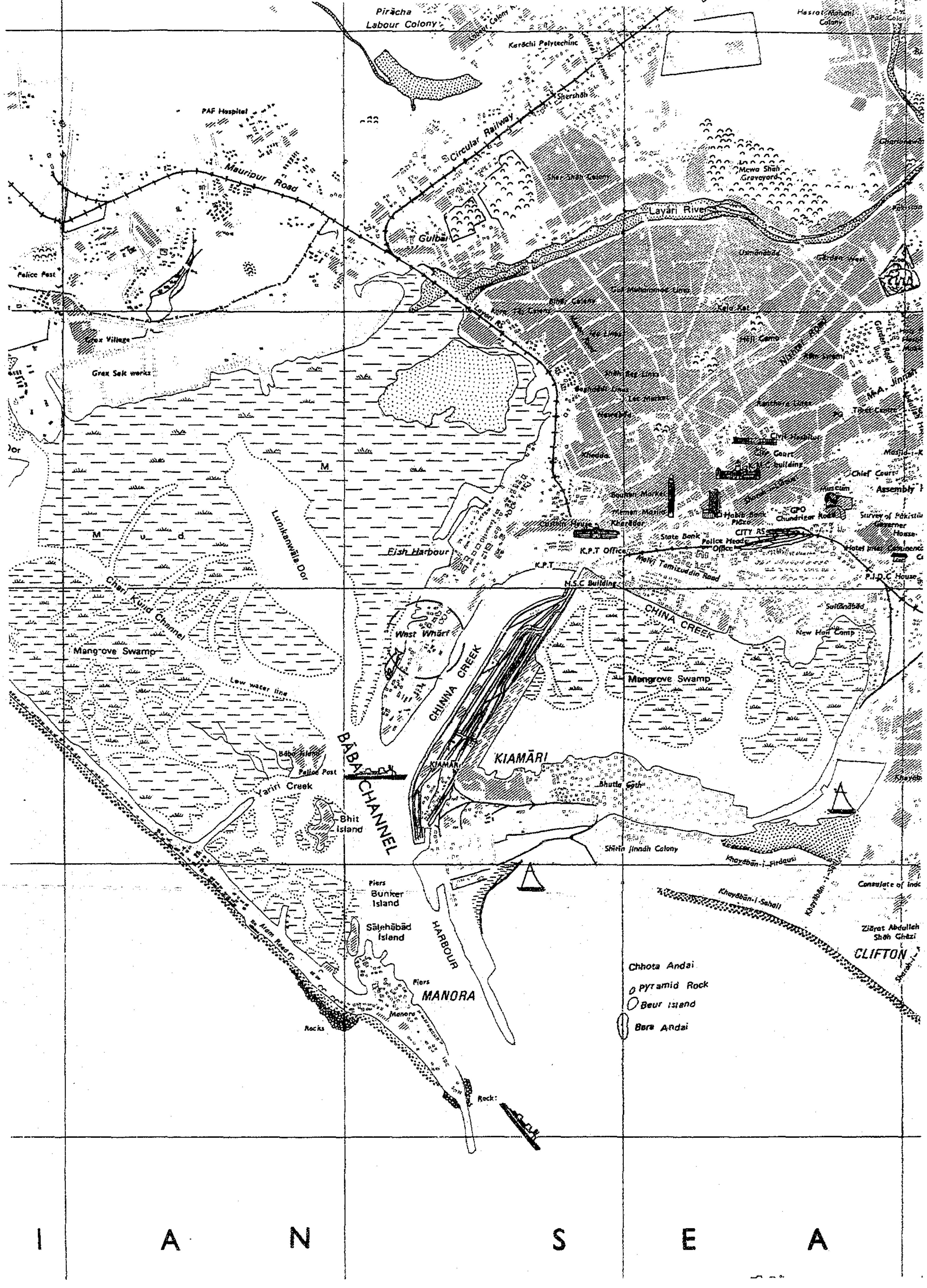
ii) Boiler — Outdoor, drum type, reheat, pressurized furnace, oil-fired, top support, natural or forced circulation.

iii) Turbine — Reheat condensing, tandem compound, double flow type

Steam condition — Main steam pressure 169 kg/cm^{2}g
Steam temperature 538°/538°C

iv) Generator — Horizontal, H_2 gas cooled, totally enclosed, synchronous machine

LOCATION OF WEST WHARF THERMAL POWER PLANT



Rated capacity	250 MVA
Frequency	50 Hz

2.2 Transmission Line(s) and Substation Facilities

220 kV transmission line(s) will be constructed between the West Wharf Thermal Power Plant and the Baldia Grid Station.
(Refer to attached drawing).

For this purpose, 220 kV and 132 kV substations will be constructed within the premises of the West Wharf Thermal Power Plant and two (2) 220 kV extension bays will be constructed in the Baldia Grid Station.

In consideration that supply of electric power be continued by the existing 11 kV and 66 kV system during the period for construction of the new plant, 11 kV distribution facilities will be left as they are, and the 66 kV power transmission and substation facilities will be subsequently dismantled by switching over to the new 132 kV system after completion of the new power transmission lines and substation facilities.

The new 132 kV system will be planned and constructed by KESC.
However, the switchyard within the power plant site will be included in the Scope of Work of this project.

(1) Associated Transmission Facilities

(i) 220 kV transmission line
(Between West Wharf P.P and Baldia G/S)

Approx. length	25 km
Number of circuits	2 cct

(ii) Extension of the Baldia Grid Station

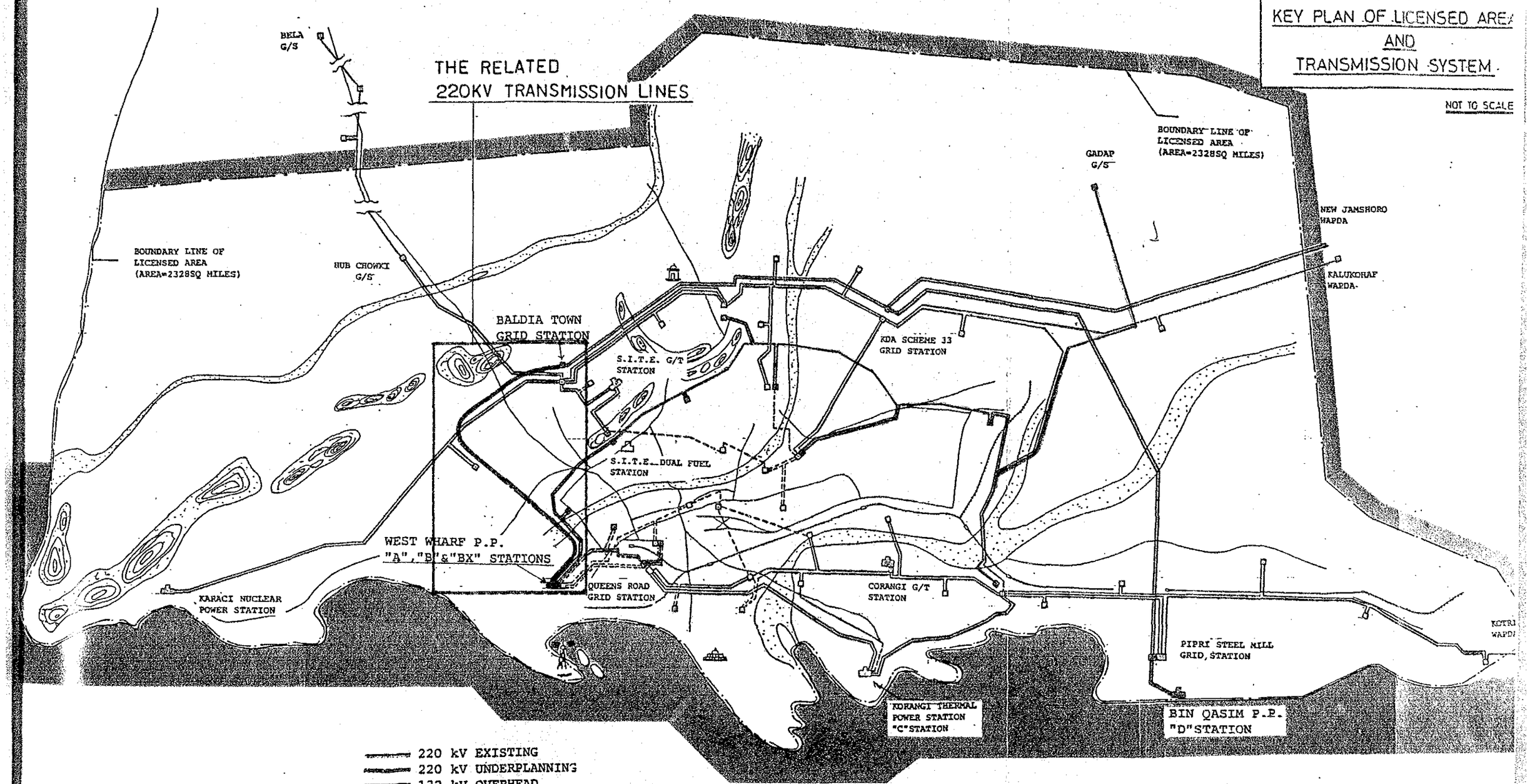
220 kV transmission bay	2 circuits

WEST WHARF THERMAL POWER PLANT PROJECT
RELATED 220KV TRANSMISSION LINES

P & D Nº: 898-F-I | MP-EST/75-
DATED 25 4. 1987

KEY PLAN OF LICENSED AREA
AND
TRANSMISSION SYSTEM.

NOT TO SCALE



220 kV EXISTING
220 kV UNDERPLANNING
132 kV OVERHEAD
132 kV UNDERGROUND
66 kV OVERHEAD
66 kV UNDERGROUND

INCLUDING PROJECT PROPOSED IN
SIXTH FIVE YEAR PLAN AND
SEVENTH FIVE YEAR PLAN

3. IMPLEMENTATION SCHEDULE

3.1 Basic Concept

The construction schedule under the optimum development plan envisages that the first 200 MW unit of the thermal power plant be completed at the end of December 1993, and the second unit at the end of March 1995, which is fifteen months after completion of the first unit.

The schedule is planned on the assumption that the contract for the first unit construction could be expected at the beginning of 1991, with a 36 month construction period for the first unit, including dismantling of the existing facilities.

3.2 Construction Schedule Key Dates:

(1)	Detailed Design Completion	Jan. 1990
(2)	Contract with Erector	Eleven (11) months after Tender announcement
(3)	Construction Start	Within One month after Contract of Lot I
(4)	220 kV Transmission Line Completion	22 months after Contract of Lot IIB
(5)	First Unit Commissioning	36 months after Contract of Lot I
(6)	Second Unit Commissioning	51 months after Contract of Lot I

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4. PROJECT COST

4.1 Construction Cost

Estimation of the construction cost of the project was revised based on the results of the Detailed Design Study. The project cost consists of two steam power generating units, 1 and 2, the civil and architectural works, the related transmission line, the substation at the West Wharf site and extension of the Baldia Grid Station, as well as the Engineering Services Fee.

The cost covers the expected freight, insurance, contingencies, equipment, materials and erection works.

As for the civil and architectural works, the construction cost is estimated based on the Bill of Quantities, which, in turn, is based on the detailed design.

The cost of power plant equipment has been revised based on the tender prices of similar equipments in Pakistan, those of the other foreign projects and in consideration of the feasibility study results of this project.

Table 4.1 Summary of Construction Cost

(1) Lot I Cost

Unit × 10^6

	F/C (Yen)	L/C (Rs)	Remarks
Power Plant			
Unit 1	19,569.84	3,945.96 (628.55)	Excluding Import Duty and Interest Fee
Unit 2	14,574.02	2,240.45 (358.42)	
Total	34,143.86	6,186.41 (986.97)	

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(2) Lot IIA Cost

	F/C (Yen)	L/C (Rs)	Remarks
Substation and Grid Station	4,808.31	845.09 (126.34)	Excluding Import Duty and Interest Fee

(3) Lot IIB Cost

	F/C (Yen)	L/C (Rs)	Remarks
Transmission	1,102.54	348.92 (55.86)	Excluding Import Duty and Interest Fee

Note) F/C: Foreign Currency
L/C: Local Currency

Project Cost

Foreign Currency	$40{,}054.79 \times 10^6$ Yen
Local Currency	$6{,}850.86 \times 10^6$ Yen
	$(1{,}096.14 \times 10^6$ Rs)

5. PROJECT PLANNING

5.1 Basic Concept

The basic plan study has been carried out based on the results of the site survey.

This basic plan study establishes the conceptual design of the plant and its system.

For this purpose, the applicable regulations, standards/criteria and codes constituting the basis of design were determined after discussions with KESC, and the design conditions (ambient conditions, properties of fuels, operation and control characteristics comprising the basis of design) were determined.

On the basis of these conditions, design of the plant system will be carried out, with the basic plan promoted as follows.

i) Design from Macroscopic Point of View

Conceptual design of the plant is carried out and a general system matching plant design (capacity, number of units, type, etc.) will be determined.

ii) Design from microscopic point of view

While determining the individual equipment (review of actual capacity and number of units, construction, operability, maintainability, etc.), the detailed plant system is established.

In order to determine the individual equipment, study was promoted from the basic plan study stage. Since the study items to determine the specifications of all equipment cover a wide range of detailed items, the results of the basic plan study will be finalized at the detailed design stage and summarized in the detailed design documents (detailed design sheets, bases of specifications, standard and calculation sheets).

At the detailed design stage, further detailed study has been carried out to technically clarify the items established by the basic plan/design.

Moreover, other detailed items which have not been studied at the basic plan/design stage have been studied (These items include the materials, construction, operability, maintenance and other technical requirements to be designated in the technical specifications).

In addition, the specifications common for various works including the applicable regulations, standards and codes were prepared as "Common Technical Specifications" (Design Standards) so as to eliminate the complexity of repeatedly designating the same items in the technical specifications for individual equipment.

Since the contracts of the construction work for this project are scheduled to be divided into four (4) lots, it was required to determine the scope of supply, contents and items of guarantees including guarantee of performance and completion period, tie-in points and so forth regarding the contracts of the respective lots. Therefore, the scope of supply/work to be assigned to the respective lots, content and items of guarantee was determined by study during the detailed design stage.

5.2 Design of the Power Plant

The major items of the plan and the design for the power plant equipment and facilities are as presented below.

(1) Heat Cycle

As the heat cycle constitutes the basis of power plant system design, the optimum steam conditions and heat cycle, were formalized.

The steam temperature and pressure, number of extraction stages, etc., were determined by taking into account optimum operating conditions and cost factors on the bases of the parameters of base load, peak load, fuel cost, cooling water system and other conditions.

The detailed description of the heat cycle is shown in GR-2 titled "Heat Balance for Turbine" of the Final Report-I.

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(2) Plant Equipment

The specifications of the power plant equipment have been studied by referring to the operation records of thermal power stations similar to the planned power stations, and highly reliable and economically excellent main power plant equipment was selected.

i) Boiler

Subcritical pressure, drum and reheat, top support type boiler was selected. Semi-indoor type was selected in view of the ambient conditions.

ii) Steam Turbine

Tandem compound, double flow and reheat turbine was selected. Moreover, optimum condenser vacuum conditions were studied taking into account the condenser cooling water temperature conditions, available flow rate, etc.

iii) Generator

Three (3) phase AC synchronous generator will be adopted. The stator and rotor hydrogen cooling system will be adopted as generator cooling system, and the field excitation system was selected by sufficiently taking into account plant system reliability.

iv) Main Auxiliary Equipment

The main auxiliary equipment types have been selected considering the following studied results.

- The capacity, number, types, materials, etc., of the circulating water pumps were studied by sufficiently taking into account the properties and temperature of sea water, tide levels and other conditions.

- The condenser tubing and bearing water cooler tubing materials were selected by taking into account the quality of sea water and sludge conditions.

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Consequently, titanium material was applied to the condenser tubes and nickle-copper alloy material was applied to the bearing cooling heatexchanger.

- In order to minimize corrosion of condenser tubes and bearing cooling water heat exchanger tubes, adoption of electrolytic corrosion preventive devices, continuous cleaning equipment, chlorination system, etc., was studied.

- With regard to the bearing cooling water system, the arrangement of pumps and coolers, layout of piping, water quality control and so forth, including the cost of these systems, was studied.

  Moreover, the backup system will avoid any trouble in the bearing cooling water system.

  As the results of study, closed cycle system was chosen.

- Since cooling water to be taken in from Karachi Port contains considerable foreign matter, the screening equipment will be designed to permit easy and effective operation and maintenance.

  To prevent the foreign matters, bar screen in front of intake mouth, bar screens with rake and traveling screens in front of Circulating water pump pit were adopted.

- The number, capacity and type, including the drive system, of boiler feedwater pumps were determined by sufficiently taking into account efficiency of the overall power plant.

  Consequently, fluid complying speed control type of the BFP has been adopted so as to save the house power consumptions in the power station.

- The feedwater drain recovery system was studied by sufficiently taking into account its control system.

- With regard to emergency power source, adoption of an emergency power generator and DC power source was studied.

v) Plant Control System

To improve the reliability of operation and control, the control and monitor/supervision system of both individual equipment and the overall plant increase in number and complexity. To maintain efficient operation of the power plant, a computer supervisory system has been adopted. Therefore, the entire control system is designed by sufficiently taking into consideration the following conditions.

- The computer system will use one computer per two power units.

- The central control room is designed on the basis of one central control room per 2 units system in view of centralized plant control, operability, controllability and cost factors.

- The following main control equipment, comprising and electronic digital control system, is recommended for improvement in reliability, safety and maintenance of unit, interface and economic factors. Moreover, adoption of the distributed type arithmetic units is considered for the main control system.

  - Automatic plant control system (APC)
  - Automatic burner control system (ABC)
  - Electro-hydraulic governor control system (EHC)

  With regard to the power plant control system (APC), adoption of a boiler/turbine coordination control system allowing coordinated control of the power system and power plant main control system/s was carefully studied and designed.

  To enable island operation of the power plant, it was decided to adopt the high speed fuel cut-back (FCB) function.

- To ensure safe unit operation, the plant interlock system is designed so as systematically match the control system.

- The plant computer is designed to be of a system for exactly monitoring/supervising startup and shutdown of the plant and provide general plant supervision and control. It will feature a host computer having respective subcontrol systems.

- The plant computer has the following functions.

  - Operation guidance and monitoring
  - Logging and trend recording
  - Efficiency calculation
  - Graphic display and hard copying

- The local control equipment, including actuators for the boiler and turbine, will be of a pneumatic type in view of reliability and maintenance.

  Except in the case of special functions, the control systems of common and auxiliary equipment will be of a relay logic or electronic logic type. However, the actuators of control equipment will be of a pneumatic type.

- Individual control systems were carefully planned so as to match the automation level of the plant.

vi) Station Electrical Circuit Plan

The appropriate electrical system (voltage and number of phases), circuit configuration and power source configuration (station service substation), including station service electrical circuits, common equipment and emergency electrical circuits, were studied so as to establish a highly reliable main circuit system.

vii) Emergency power source

The emergency power source is planned so as to enable supply from the emergency AC power generator and the DC battery.

The emergency AC generator is planned to adopt diesel engine as its

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driving prime-mover.

The emergency power source is designed to supply electric power to the loads required to enable safe unit shutdown, lighting at the time of total power supply failure and speedy restart of unit.

The emergency loads will consist of the turbine auxiliary pump, turning gear, turning gear oil pump, seal oil pump, feedwater pump and other auxiliary oil pumps for large capacity auxiliaries as well as battery charger, a power source for control, communication and emergency lighting.

viii) Substation/Switchyard Plan within the Plant Site

The substation/switchyard within the plant site is intended to transmit electric power generated by the new power plant. As reliability is the main objective, these facilities were planned and designed by sufficiently taking into account the severe coastal conditions.

The selection and arrangement of main equipment was studied so as to minimize the occupied area of equipment by adopting gas insulation switchgear (GIS).

In view of the importance to ensure coordination between the substation/switchyard within the plant site, transmission line and power plant, adoption of a suitable protective relaying system was determined.

ix) Station service water system

The amount of service water was determined by study on the possibility of reusing waste water in accordance with the overall plan and operation of the power plant. At the same time, an overall balance of the amount of service water and waste water is studied to decrease service water consumption.

2/

Regular use service water

- Plant makeup water, drinking water, water for demineralizing plant and other miscellaneous service water.

Non-regular use service water

- Plant startup service water, air preheater equipment washing water, boiler chemical cleaning water, water for hydrostatic test of condenser, miscellaneous service water at the time of periodic maintenance and inspection of plant, etc.

x) Waste water treatment equipment

With regard to the waste water treatment equipment, a balance sheet of the waste water from the entire power plant is prepared. On the basis of this balance sheet, planning of efficient use of station service water and waste water treatment system design are carried out.

For preventing environmental pollution, waste water is planned to be suitably treated before discharging from system to outside of the power plant.

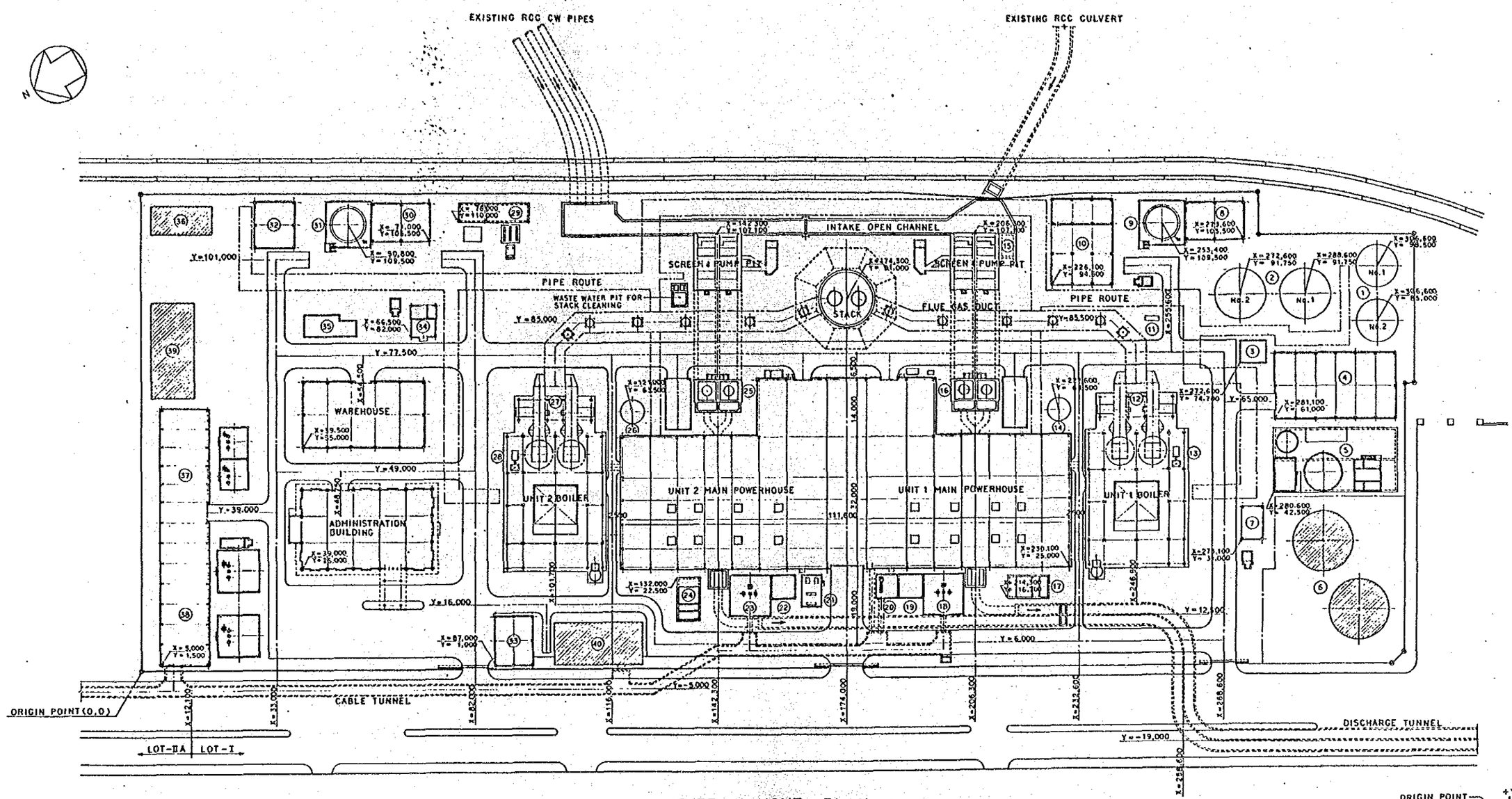
xi) Fire extinguishing equipmnent

The fire extinguishing system is classified into the demineralized water fire extinguishing, sea water fire extinguishing, air foam, chemical extinguishing and fire alarm systems.

In consideration of the occurrence of fire accidents, the optimum fire extinguishing systems matching the respective equipment and facilities is selected.

(3) Determination of the plan of power plant and arrangement of equipment

The arrangement of equipment within the power plant site is carefully studied in view of the effect upon operation, maintenance, occurrence of trouble and countermeasures.

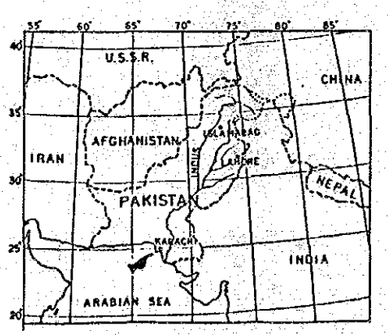


SITE LAYOUT PLAN

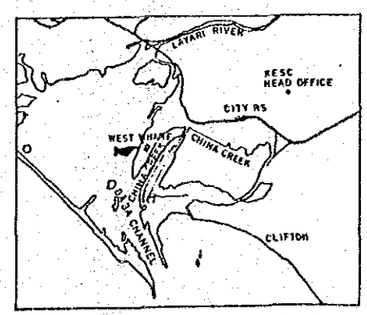
SCALE 1 : 500

No.	DESCRIPTION
1	Demineralized Water Tank
2	Raw WaterTank
3	Chemical Storage Tank
4	Water Treatment Equip. & Control Room
5	Waste Water Treatment Area
6	Fuel Oil Storage Tank(Existing)
7	Fuel Oil Transfer Pump
8	Unit 1 Fuel oil Pump & Heater Area
9	Unit 1 Fuel oil Service Tank
10	Chlorination Equip. Area & Control Room
11	Air Foam Equipment Area
12	Unit 1 Forced Draft Fan
13	Unit 1 Gas Recirculating Fan
14	Unit 1 Make-up Water Tank
15	Chlorination Feed Water Pump Pit
16	Unit 1 Circulating Water Pump
17	Unit 1 Unit Neutralizing Pit
18	Unit 1 Main Transformer
19	Unit 1 Auxiliary Transformer
20	Starting Transformer

No.	DESCRIPTION
21	Turbine Oil Storage Tank
22	Unit 2 Auxiliary Transformer
23	Unit 2 Main Transformer
24	Unit 2 Unit Neutralizing Pit
25	Unit 2 Circulating Water Pump
26	Unit 2 Make-up Water Tank
27	Unit 2 Forced Draft Fan
28	Unit 2 Gas Recirculating Fan
29	Raw Water Pretreatment Area
30	Unit 2 Fuel oil Pump & Heater Area
31	Unit 2 Fuel oil Service Tank
32	House Boiler Area
33	Guard House
34	H_2 Gas Generating Room
35	Storage Box for Stop Log
36	Existing Gas Station(Sui Gas)
37	132kV Substation
38	220kV Substation
39	66kV Switchyard Indoor(Existing)
40	11kV Grid Station(Existing)



PAKISTAN MAP



LOCATION MAP

ORIGIN POINT

GRAPHIC SCALE

SCALE 1 : 500

PAKISTAN

KARACHI ELECTRIC SUPPLY CORPORATION

WEST WHARF THERMAL POWER PLANT PROJECT

UNITS NO.1 AND NO.2

SITE LAYOUT PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO JAPAN

APPROVED BY	REVIEWED BY	CHECKED BY	DRAWN BY

DRAWING NO. WAT – 1001 | SCALE 1 : 500 | DATE 10 JAN 1992

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The arrangement of power plant equipment was planned and decided, and an optimum arrangement of power plant equipment was determined by taking into account the special conditions of this project for redevelopment of the existing power stations.

The general arrangement plan of the power plant is as indicated in DWG. No. WAT-1001. (Refer to attached drawing).

According to the general arrangement plan, two 200 MW oil-fired thermal power units are arranged within a narrow site area taking into account the various restrictive conditions inherent to this redevelopment project. Careful utilization is made of the existing cooling water systems, oil storage facilities and other installations.

A more detailed general arrangement plan was worked out taking into consideration the following points.

(i) The arrangement plan of the following equipment was worked out by taking into account the flow of energy.

- Fuel receiving facilities
- Fuel storage facilities
- Main powerhouse building, stack and other associated facilities
- Cooling water intake and discharge systems
- Substation and switchyard

(ii) The boiler and main powerhouse building are to be located as close as possible to each other to minimize the length of station service piping.

(iii) The substation/switchyard is planned and arranged in consideration of the relationship with the outgoing transmission line and existing equipment and facilities.

JK

(iv) The water treatment equipment, waste water treatment equipment and other common facilities will be located in an integrated manner at one position where practicable to ensure effective utilization.

Major power plant equipment is accommodated within the power plant site, while the cooling water intake system, discharge system and fuel storage facilities will be installed in the site area adjacent to Karachi Port Trust, Karachi Shipyard and CALTEX, respectively.

As for the fuel oil storage and supply system, the existing PSO (Pakistan State Oil Co.) oil tanks and supply line from a refinery will be utilized for the fuel oil storage and supply system.

(4) Environmental Protection

On the occasion of planning a power plant development project, environmental protection becomes a subject of major concern.

In Pakistan, as elsewhere, general concern for environmental protection will grow in a proportionate ratio to the development of industrial and commercial activities.

At present, concerning air pollution in Pakistan, there is a regulation titled "Environmental Emission Standard for Industrial Gaseous Emission". However, no other standard has yet been formulated which is applicable to power plants.

There is also the "Specific Standards and Guidelines for Thermal Power Stations", an environmental action plan, now being prepared by the Environmental & Urban Affairs Division in collaboration with the Planning & Development Division, Energy Wing. These Standards will be finalized by October 31, 1991.

For the above reason, we propose that the relevant and authoritative World Bank Emission Standards be adopted.

JICA has carried out a study on SOx and NOx emission of the West Wharf Power Plant, taking into account the World Bank recommended values as well as the Japanese regulations.

(i) In order to satisfy the ground level concentrations of SOx and NOx, a 140 m height of stack is adopted.

(ii) Regarding NOx emission from the boiler, the necessary performance will be specified in the Tender Documents so as to keep the NOx emission below the specified value.

(iii) Liquid Effluents

As for controlling of liquid effluents, there is the Pakistani standard "Environmental Emission Standard for Municipal and Liquid Industrial Effluents", issued by the above mentioned Environmental & Urban Affairs Division.

Note that this standard does not much differ from the Japanese relevant standard.
Therefore, to meet the regulation values of the Pakistan and the Japan, Coagulation-Sedimentation with neutralization system has been adopted.

5.3 Plan of Civil Work

(1) Clarification of Regulations, Standards and Codes

The design criteria to be followed, as well as the laws and regulations to be applied in executing detailed design of civil work facilities have been investigated and determined after discussion with KESC.

(2) Clarification of Design Conditions

Based on the results of analysis and evaluation of site survey, the following design conditions have been established.

i) Materials to be used and their allowable stress.

ii) Various constants of Ground Conditions

- C, ϕ and other strength constants

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- Coefficient of lateral ground reaction of pile and modulus of elasticity of ground.
- Bearing capacity of pile and constant pertaining to bearing capacity of ground.
- Coefficient of permeability of ground water
- Ground water level

iii) Loads

- Dead weight of reinforced concrete
- Vertical and horizontal soil pressures
- Wind load
- Earthquake load
- Group load, live load and vehicle load
- Other loads

  Equipment load, water hammer load, etc.

iv) Hydraulic Constants

- Design water level and tide level
- Wave conditions
- Coefficient of wall roughness of water channel

(3) Determination of the Layout of Civil Work Facilities

In parallel with determination of the basic plan and design of the major power

plant equipment, the final layout and coordinates of the civil work facilities have been determined.

(4) Design Concept of Civil Work Facilities

The design concept of the following major civil work facilities have been established.

- Intake open conduit
- Intake screen and pump room
- Condenser cooling water systems (Intake channel and discharge outlet)
- Various foundations for outdoor equipment
- Various storage tanks (water treatment and pits)
- Others

5.4 Design of Architectural Structures

The basic plan/design of buildings have been carried out by sufficiently taking into account the features of the environment and site.

(1) Construction of New Thermal Power Plant during Operation of Existing *Thermal Power Stations*

Since the dismantling work of "A" Station and construction Unit I is scheduled to be carried out during operation of the existing "BX" Station, careful consideration must be paid to the power plant equipment in operation. To prevent excessive noise, vibration and avoid any erroneous shutdown of the "BX" Station, particularly during the dismantling work, and considering that the work will be carried out in an urban area, adoption of low noise and low vibration heavy-duty equipment will be studied. Due to the narrow site area, overturn of any heavy-duty equipment, collapse of an excavation face or other trouble can cause not only adverse effects on the construction schedule but also damage to the equipment in operation.

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Therefore, the work specifications will be prepared and the work methods specified so as to positively ensure the safety of work.

(2) Reduction of Weight and Adoption of Prefabrication for Building

In the main powerhouse building, a variety of auxiliary equipment is arranged on the first floor and the upper stories. Therefore, it is required to reduce the dead weight of the building as much as possible in view of the axial force of columns, lateral force at the time of earthquake as well as construction costs. For example, adoption of steel frames for structures, metal materials for roof and exterior wall materials (instead of concrete materials), and introduction of other new architectural/structural materials have been studied to reduce building weight.

As the site area is limited in space, it will be planned to timely transport prefabricated materials to the site and erect the materials so as to minimize the field work space. This system will also be advantageous in view of schedule control and manpower saving.

(3) Selection of Materials to be Used

With regard to the materials to be used, the production conditions, quality and supply capacity of various materials in Pakistan, particularly in the Karachi area, will be studied so as to use local materials whenever possible.

(4) Rational Floor Plan, Elevation Plan and Column Spacing of Building

Following study on the arrangement of building/s on the equipment side and the requirements for building arrangement, the floor and elevation planning have been carried out by making utmost use of the limited site area and development conditions inherent to this project. As the structural plan of building (column spacing and arrangement of vertical bracing) is considered to greatly effect the arrangement of equipment, this planning has been carried out integratedly through full-scale coordination among JICA engineers responsible for architectural/structural and equipment matters. The building exterior is designed in consideration of the surrounding scenery and external building appearance, as the building site is located in a port area adjacent to

the urban area and the main powerhouse building and boiler structures will directly face city street.

(5) Stack/chimney

The stack is of a construction wherein two (2) inner flues for Units 1 and 2 are arranged in one (1) concrete-made outer shield. A concrete outer shield erection method, meeting the overall schedule, is selected.

5.5 Plan of 220 kV Transmission Line and Substation Facilities

The basic plan/design of the 220 kV transmission line for connection between the West Wharf Thermal Power Plant and the Baldia Grid Station as well as that of associated substation facilities has been carried out.

The establishment of basic transmission line route/s,selection of materials to be used, and execution planning of construction have been carried out to attain reliability and economic optimization.

The transmission line route and underground cable route have been planned by taking into account matters related to housing density of the area, the shipyard area, traffic conditions, and so on from the West Wharf project site to the area adjacent to the Layari River mouth.

As it is predicted that the ground is soft and the bearing stratum is located at a considerable depth in some locations, an optimum route has been selected.

Appropriate insulation measures have been determined so as to ensure coordination with the existing transmission line while taking into account salt contamination in the coastal zone and contamination of insulators due to sand and dust on the Baldia Grid Station side.

The basic plan of the transmission line and substation facilities has been worked out as described below.

(1) Determination of Transmission Line Route

(2) Clarification of Design Criteria and Conditions, and Standardization of Equipment

Subsequent to investigating the design criteria and operation records of the existing facilities of KESC, the design criteria and conditions applicable to the power system plan under this project have been established while taking into account the climatic and environmental conditions, local situations in Pakistan and international design criteria and conditions.

(3) Insulation Level

As the transmission line route is located in a coastal area, a part of the route lis expected to pass along the sea coast and across a swampy area. Therefore, salt contamination and other conditions were investigated, with appropriate insulation levels established so as to withstand abnormal internal voltage and ensure coordination with mutually interconnected transmission lines and substation equipment.

(4) Selection of Conductor

The economically optimum type, size and number of conductors excellent in electrical and mechanical properties having the requirements to the transmission capacity and system stability, were selected.

(5) Lightningproof Design

By investigating matters related to lightning attacks along the transmission line route and records of damage to transmission lines due to lightning, effective and economically optimum lightning-proof design of the power system has been carried out.

(6) Design of Transmission Tower

Following clarification of the geological, topographical and environmental conditions including local regulations in the areas along the transmission line route, the transmission towers are designed so as to sufficiently withstand

various natural conditions as well as electrical and mechanical conditions. Also, this design will enable easy construction work, maintenance and inspection while simultaneously taking into account countermeasures for safety.

As the transmission line is expected to be routed in parallel to the existing 66 kV transmission line near the West Wharf Power Station, common stringing on the existing 66 kV transmission line is taken into account in the transmission tower design.

(7) Design of Transmission Tower Foundation

In accordance with study results of the geological and topographic surveys and determination of the conditions of loads to the transmission towers, optimum tower foundation design has been carried out on the basis of these design conditions while taking into account ease of construction and economical costs.

(8) Design of Underground Transmission Line

As it is expected to be difficult to acquire land for the transmission line adjacent to the power station along the transmission line route outgoing from the switchyard at the West Wharf Thermal Power Station, an underground portion of the transmission line is envisaged.

Consequently, underground line installation methods, cable specifications, etc., were determined after study on electrical and mechanical characteristics, with the design ensuring ease of construction, maintenance and inspection as well as economy.

During study and design of cable pits or tunnels, JICA has held detailed discussions with KESC on future cable installation plans, type and quantity of cables. Also, a combined plan and multi-purpose use of cable pits or tunnels have been studied.

5.6 Dismantling and Removal Plan of Existing Power Station

The dismantling methods and period of the existing power station/s will be studied and the dismantling cost estimated.

In the case of the "A" Station, only its building, machine pedestal and foundation remain. Therefore, removal of the foundation comprises the major dismantling work in the case of the "A" Station.

On the occasion of site survey of foundation and foundation piles, parts of the ground around the equipment foundation of "A" Station have been excavated. According to the survey result, it lis confirmed that there are no existing piles under the foundations.

In the case of the "B" and "BX" Stations, the foundation and foundation piles including the power plant equipment, are required to be dismantled and removed. During the basic plan/design stage, the overall dismantling work volume of equipment, buildings and foundations, and procedures for dismantling and removal have been studied.

Following selection of the equipment which can be reused and studying the values of scrap and temporary storage yard (dismantling site), the final decommissioning method will be studied after sufficiently incorporating the intentions of KESC.

(1) Preparation of the technical specifications for dismantling work will be promoted based on the following process.

- Study of local environment conditions and transportation route of dismantled materials
- Study of the methods, procedures and schedule of the work according to locale conditions, construction, etc., of equipment and facilities to be dismantled
- Advice/recommendation regarding machinery, equipment, tools and materials taking into account the safety and efficiency of the work
- Study of work execution procedures taking into account the size and weight of unit blocks to be dismantled, construction machines to be used, safety countermeasures and work sequence
- Procedures for determining transportation destination based on the kinds of materials, and transportation plan

- Study of the disposal methods for industrial wastes

- Preparation of technical specifications for dismantling

(2) Preparation of Drawing for Tendering

Related drawings will be prepared based upon the Detailed Design.

The following drawings will be used as part of the Tender Documents.

- Arrangement of existing plant facilities
- Planning of temporary facilities
- Dismantling procedures for existing machinery
- Dismantling procedures for existing electrical equipment
- Dismantling procedures for civil construction work
- Dismantling procedures for architectural/structural work

6. CONSTRUCTION SCHEDULE

6.1 Preparation of Construction Schedule by Bar Chart

The construction schedule for two (2) units of 200 MW oil fired thermal power generating facilities of the West Wharf Thermal Power Development Project has been prepared in the form of a bar chart, together with that for the transmission lines between the Baldia Grid Station and the West Wharf Power Plant and their related facilities.

The project is intended to construct the new power plant by utilizing the existing plant site. As the site area is restricted in dimensional size and because a portion of the existing facilities must be kept in operation during the construction period, the construction schedule was carefully prepared by the Study Team. After analyzing all construction work, the Study Team proposed the related sequences of each work activity for approval by KESC.

Key dates of the construction schedule are proposed to ensure proper, effective and balanced construction coordination among respective contractors. These key dates will be chosen in more detail based on full understanding of project construction work and the experience of contractors in similar projects.

As the civil work will be executed in close relationship with dismantling of certain existing structures as well as with works outside of the power plant site, it is naturally anticipated that civil work progress will greatly affect the total project construction schedule. Therefore, the civil work schedule has been prepared by carefully considering the following items.

(1) Dismantling procedures, including their sequences, of the existing structures

(2) Rehabilitation method of the existing 10 feet square cooling water intake culvert, which had been installed for future use.

(3) Planning of temporary facilities for cooling water intake open culvert, screen and circulating pump pits, intake culverts to CWP pits for each construction stages.

(4) Excavation planning of major civil structures and their excavation sequence.

(5) Construction method of underground portion of cooling water discharge lines.

(6) Temporary shut off method of cooling water discharge outlet.

(7) Others

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MESSRS: KARACHI ELECTRIC SUPPLY CORPORATION

PROJECT: WEST WHARF THERMAL POWER PLANT PROJECT

SCHEDULE OF IMPLEMENTATION (TENTATIVE)

No. WGT-1003

DATE 10TH JAN 1990

DIV.

COPY TO

PROGRES MONTHS -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

MASTER SCHEDULE

UNIT 1 C/S P/S M/F TSS BSS D/L BHT P/R I/F I/S C/O

UNIT 2 DM/S P/S M/F TSS BSS D/L BHT P/R I/F I/S C/O

LOT I

POWER PLANT EQUIPMENT & CIVIL AND ARCHITECTURAL

LOT I

UNIT 1 C/S

DESIGN & MANUFACTURING

SHIPPING P/S

PILING

M/F FOUND. UNIT 1 MAIN POWER HOUSE

PREPARATION

MAT FOUNDATION

AUX. FOUNDATION

BOILER SHIPPING

T/G ROOM SHIPPING

STEEL STRUCTURE

BSS BOILER STRUCTURE

D/L CHIPPING

BOILER ERECTION

T/G PEDESTAL

T/G ERECTION

BHT BOILER ERECTION

AUX. ERECTION

ELECTRICAL ERECTION

P/R T/O

T/O

I/S T/O

UNIT 1 C/O

DISCHARGE TUNNEL CONSTRUCTION

INTAKE CHANNEL PUMP PIT CONSTRUCTION

CWP. SCREEN ETC. INSTALLATION

PLANT WATER FOUNDATION & ERECTION

OUTDOOR PIPE SUPPORT FOUND. & ERECTION

ST/PIPE INSTALLATION

SUPER STRUCTURE

PLANT WATER OUTDOOR PIPE INSTALLATION

T/G ROOM SHIPPING

UNIT 2 DM/S P/S M/F TSS D/L CHIPPING T/G ERECTION T/O I/S T/O UNIT 2 C/O

"A" "B" DISMANTLING BELOW GROUND

MAT FOUND. BSS T/G PEDESTAL BHT T/O

BOILER STRUCTURE D/L BOILER ERECTION BOILER ERECTION

BOILER SHIPPING

AUX. FOUNDATION AUX. ERECTION T/O

DISCHARGE TUNNEL CONSTRUCTION

INTAKE CHANNEL PUMP PIT CONSTRUCTION

CWP. SCREEN ETC. INSTALLATION

OUTDOOR PIPE SUPPORT FOUND. & ERECTION

ST/PIPE INSTALLATION

UNIT 1 P/S

LOT II

DISMANTLING WORKS

LOT II

C/S "A" & FLATS

"B" & ABOVE GROUND

"BX" ABOVE GROUND

ADMN. BUILDING CONSTRUCTION

LOT IIA

SUBSTATION & GRID STATION

LOT IIA

C/S DESIGN & MANUFACTURING SHIPPING 220kv, 132kv INSTALLATION C/O TEST

PILE SHIPPING PILING FOUND. STEEL SHIPPING STRUCTURE FINISHING A/C VENT PLUMBING

CABLE TUNNEL CONSTRUCTION CABLING

PREPARATION

DISMANTLING "B" DISCHARGE WAY INCLUDING TRNFO. WORK

LOT IIB

220/132kv TRANSMISSION LINE

LOT IIB

C/S DESIGN & MANUFACTURING SHIPPING TOWER ERECTION C/O TEST

TOWER FOUNDATION WORKS STRINGING

OWNER'S WORKS

SHIFTING WORKS OF 66kV OUTDOOR SWITCHYARD (6 MONTHS)

SHUT-DOWN OF "BX"

C/S : CONTRACT SIGNING
P/S : PILING START
M/F : MAT FOUNDATION START
TSS : TURBINE STEEL STRUCTURE START
BSS : BOILER STEEL STRUCTURE START
D/L : DRUM LIFTING
BHT : BOILER HYDROSTATIC TEST
P/R : POWER RECEIVING
I/F : INITIAL FIRING
I/S : INITIAL STEAMING
C/O : COMMERCIAL OPERATION
T/O : TEST & TRIAL OPERATION
DM/S : DISMANTLING WORK START
AUX. : AUXILIARY EQUIPMENT
GP : GUARANTEE PERIOD
▭ : INTERNATIONAL TENDER
▭ : OWNER'S WORK
◉ : EVENT
◎ : KEY DATE OF THE CONTRACT

REMARKS

REV. No.	APPROVED BY	CHECKED BY	DRAWN BY
REV. DATE			
CONTENTS			

7. PROJECT COST

7.1 Detailed Cost Estimation

The optimum development plan of the West Wharf thermal Power Plant Project envisages construction of two (2) sets of 200 MW oil fired thermal power generating units with related 220 kV transmission lines and substations.

Construction cost of the optimum development plan is estimated in detail and broken down into local and foreign currencies.

The construction cost is estimated based upon the specifications to be decided in the Detailed Design, with reference to the average costs in Japan, tender prices of similar equipment in Pakistan, local material costs, local labour costs, etc.

The construction cost is calculated in accordance with the "Bill of Quantity" based on detailed drawings made in the study.

Material costs, engineering fees and ocean freight costs of material to be procured from outside Pakistan are estimated in foreign currency, with those procured in Pakistan estimated in local currency.

The extent of materials to be purchased in Pakistan is selected and chosen by careful investigation, referring to the material informations obtained in the Feasibility Study, information from KESC, the project experiences in Pakistan, etc.

Table 7.1 Breakdown Cost

Lot I Power Plant Equipment

Unit × 10^6

	Estimated Cost		Remarks
	F/C (Yen)	L/C (Rs)	
Unit 1			
1. Architectural and Civil	2,5158.15	1,534.56 (245.53)	
2. Power Plant Equipment			
a. Boiler and its auxiliaries	3,942.86	587.57 (93.97)	
b. Turbine and its auxiliaries	4,479.28	321.96 (51.51)	
c. Common Auxiliary	1,841.34	250.00 (40.00)	
d. Electrical Equipment	3,212.40	157.69 (25.23)	
e. Plant Computer	380.00	(including items a~ d)	
3. Spare Parts	710.12	-	
4. Ocean Freight	973.48	-	
5. Training	67.93	17.25	
6. Departmental Expenses	18.75	137.50 (22.00)	
7. Escalation	-	320.43 (51.27)	
8. Contingencies	692.82	493.75 (79.00)	
9. Consultant Fee	692.71	125.25 (20.04)	Converted ratio 1 Rs = 6.25
Total	19,569.84	3,945.96 (628.55)	

Unit x 10^6

	Estimated Cost		Remarks
	F/C (Yen)	L/C (Rs)	
Unit 2			
1. Civil and Architectural	994.22	754.00 (120.64)	
2. Power Plant Equipment			
a. Boiler and its auxiliaries	3,942.86	536.75 (85.88)	
b. Turbine and its auxiliaries	4,349.90	210.69 (33.69)	
c. Common Auxiliary	677.70	110.00 (17.60)	
d. Electrical Equipment	2,473.30	135.31 (21.65)	
e. Plant Computer	76.00	- (including items a ~ d)	
3. Spare Parts	420.00	-	
4. Ocean Freight	708.91	-	
5. Departmental Expenses	18.75	137.50 (22.00)	
6. Escalation	-	258.75 (41.40)	
7. Contingencies	597.38		
8. Consultant Fee	315.00	97.25 (15.56)	Converted ratio 1 Rs = 6.25
Total	14,574.02	2,240.25 (358.42)	
Unit 1 + Unit 2	34,143.86	6,186.21 (986.97)	

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Lot IIA Substation and Baldia Grid Station

Unit × 10^6

	Estimated Cost		Remarks
	F/C (Yen)	L/C (Rs)	
Lot-IIA			
1. Civil and Architectural Work (including cable tunnel)	901.87	55.41	
2. Electrical Parts			
a. 6 × 220kV single core U/G Cables from W.W to Tower No. 1	562.00	56.88 (9.10)	
b. Substation (220kV/132kV GIS)	2,420.00	93.79 (15.00)	
c. 2 × 220kV Bays at Baldia incoming line	505.00	53.13 (8.50)	
3. Spare Parts	70.00	-	
4. Ocean Freight	75.00	-	
5. Escalation	-	518.75 (83.00)	
6. Contingencies	219.44	53.13 (8.50)	
7. Consultant Fee	55.00	14.00 (2.24)	Converted Ratio 1 Rs = 6.25
Total	4,808.31	845.09 (126.34)	

Lot IIB Transmission and Related Facilities

Unit × 10^6

	Estimated Cost		Remarks
	F/C (Yen)	L/C (Rs)	
Lot IIB			
1. Material	898.48	-	
2. Ocean Freight	85.59	-	
3. Erection including Civil Work and Testing	12.50	298.68 (47.79)	
4. Training	1.00	3.12 (0.50)	
5. Departmental Expenses	1.87	13.75 (2.20)	
6. Contingencies	49.80	15.62 (2.50)	
7. Consultant Fee	53.30	17.75 (2.87)	
Total	1,102.54	348.92 (55.86)	

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ATTACHEMENT

ATTACHMENT-1

WEST WHARF THERMAL POWER PLANT PROJECT
DETAILED DESIGN STUDY
(FINAL REPORT - I)

The items are itemized one by one and are arranged in the following categories with identification numbers.

	Category	Designation
VOLUME 1	POWER PLANT EQUIPMENT	
	Preface	I
	General Plant	GP
	Mechanical	M
	Common Auxiliaries	C
	Electrical	E
	Plant Interlock and Control	PIC
	Environmental Protection	EP
	Project General	PR
VOLUME 2	TRANSMISSION LINE AND GRID STATION	TLG
VOLUME 3	ARCHITECTURAL AND STRUCTURAL	AR
	CIVIL WORKS	CV

VOLUME 1 POWER PLANT EQUIPMENT

Section 1. Introduction

I-1 Preface

I-2 Outline of the Project

I-3 Site condition and Design Condition

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Section 2. General

GP-1 Plant Performance

GP-2 Heat Balance for Turbine

GP-3 Optimum Steam Condition

GP-4 Optimum Condenser Vacuum

GP-5 Number of Feedwater Heaters

Section 3. Mechanical

M-1 Boiler

M-2 Boiler Auxiliaries

M-3 Turbine

M-4 Turbine Auxiliaries

M-5 Condenser and Circulating Water System

M-6 Condenser Tube Materials

M-7 Feedwater Heating System

M-8 Type and Number of Boiler Feed Pump

M-9 Bearing Cooling Water System

M-10 Main Steam and Reheat Steam Pipeline Route

M-11 Sizing of Pipelines

M-12 Outdoor Piping

Section 4. Common Auxiliaries

C-1 Fuel Oil System

C-2 Fuel Oil Heating System

C-3 Natural Gas System for Auxiliary Fuel

C-4 Plant Service Water System

C-5 Waste Water Treatment System

C-6 Chemical Feed System

C-7 Chlorination System

C-8 Condenser Protection System

C-9 Maintenance Facilities for Screen and CWP Pit Area

C-10 Fire Protection System

Section 5. Electrical

E-1 Capacity of Auxiliary Transformer

E-2 Capacity of Starting Transformer

E-3 Impedance of Auxiliary Transformer

E-4 Impedance of Starting Transformer

E-5 Capacity of Battery and Battery Charger

E-6 Capacity and Design Criteria of Emergency Diesel Engine Generator

E-7 Capacity of Generator NGR Transformer

E-8 Minimum Capacity of Generator Surge Absorber

E-9 Short Circuit Capacity of IPB

E-10 Bus Voltage of Electric Circuit

E-11 Required Grounding Resistance Value

E-12 Design Criteria of Substation

E-13 Basic Requirement of Lighting System

Section 6. Plant Interlock and Control

PIC-1 Plant Interlock

PIC-2 Concept of Plant Control System

PIC-3 Turbine Bypass System

PIC-4 Application of Computer System for Power Plant

PIC-5 Boiler Control System

PIC-6 Burner Control System

PIC-7 Turbine Governing System

Section 7. Environmental Protection

EP-1 Study of SOx and NOx Concentration

EP-2 Water Pollution

EP-3 Noise Control

Section 8. Project Implementation

PR-1 Construction Schedule

VOLUME 2 TRANSMISSION LINE AND GRID STATION

TIG-1 Overhead Transmission Line

TLG-2 Underground Cable

TLG-3 Cable Channel

TLG-4 Extension of Baldia Grid Station

VOLUME 3 ARCHITECTURAL AND CIVIL WORKS

Section 1. Architectural and Structural

AR-1 Structural Calculation Sheets for Main Powerhouse Superstructure

AR-2 Structural Calculation Sheets for Main Powerhouse Superstructure

AR-3 Structural Calculation Sheets for Stack

AR-4 Structural Calculation Sheets for Administration Building

AR-5 Structural Calculation Sheets for Auxiliary Buildings

AR-6 Structural Calculation Sheets for Outdoor Equipment Foundations

AR-7 Calculation Sheets for Air-Conditioning and Ventilation System for Main Powerhouse

AR-8 Calculation Sheets for Air-Conditioning and Ventilation System for Administration Building

Section 2. Civil Works

CV-1 Civil Design Condition

CV-2 Basic Data Obtained from the Hydraulics Study at the Cooling Water Way

CV-3 Hydrographic Calculation

CV-4 Structural Calculation of Intake Open Channel

CV-5 Structural Calculation of Pump Pit

CV-6 Structural Calculation of Discharge Tunnel

CV-7 Structural Calculation of Outlet

CV-8 Structural Calculation of Retaining Wall

ATTACHMENT-2

WEST WHARF THERMAL POWER PLANT PROJECT

TENDER DOCUMENTS

(FINAL REPORT-II)

Tender documents and technical specifications concerning the procurement of power plant facilities and construction of the project is complied to contain the items described below.

LOT I: POWER PLANT FACILITIES

			Symbol Mark
VOLUME 1			
Section I	:	Instructions to Tenderers	IT
Section II	:	Tender and Appendices	FTA, etc.
Section III	:	General Conditions of Contract	CC
Section IV	:	Conditions of Particular Applications	PA
VOLUME 2		Tenderer's Data Sheets	
Section I	:	Power Plant Unit	DU
Section II	:	Steam Generator and Auxiliary Equipment	DB
Section III	:	Steam Turbine and Auxiliary Equipment	DT
Section IV	:	Common Auxiliary Equipment	DC, DCA
Section V	:	Generator and Electrical Equipment	DE, DEA
Section VI	:	Plant Computer System	DP

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			Symbol Mark
Section VII	:	Schedule of Contractor's Representatives Manufacturer's Specialists, Election Specialists, Technicals, Erection Workers and Labours, and Technical Advisors for Power Plant Equipment	SC
Section VIII	:	Erection Equipment and Tool List	ET

VOLUME 3 Technical Specifications

PART I : Technical General Conditions

Section I	:	Technical General Conditions	TC
Section II	:	Design Standards	DS

VOLUME 4

PART II : Power Plant Equipment

Section I	:	General Specifications	GL
Section II	:	Steam Generator and Auxiliary Equipment	B
Section III	:	Turbine and Auxiliary Equipment	T
Section IV	:	Common Auxiliary Equipment	C
Section V	:	Generator and Electrical Equipment	E
Section VI	:	Plant Computer System	P

VOLUME 5

PART III : Architectural, Structural and Civil Works

Section I	:	General Specifications	GS
Section II	:	Technical Specifications	TS

VOLUME 6 Drawings for Tendering

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LOT IIA: SUBSTATIONS AND RELATED FACILITIES

			Symbol Mark
VOLUME 1			
Section I	:	Instructions to Tenderers	IT
section II	:	Tender and Appendices	FT, DE
Section III	:	General Conditions of Contract	CC
Section IV	:	Conditions of Particular Applications	PA
VOLUME 2			
PART I	:	Technical General Conditions	TC
PART II	:	Substation and Related Facilities	
Section I	:	Substation and Grid Station Facilities	ES
Section II	:	220 kV Underground Cables	UG
PART III	:	Architectural and Civil Works	
Section I	:	General Specifications	GS
Section II	:	Technical Specifications	TS
VOLUME 3		DRAWINGS FOR TENDERING	

LOT IIB: TRANSMISSION LINE(S) AND RELATED FACILITIES

			Symbol Mark
VOLUME 1			
Section I	:	Instruction to Tenderers	IT
Section II	:	Tender and Appendices	FTA,DJ, etc.
Section III	:	General Conditions of Contract	CC
Section IV	:	Conditions of Particular Applications	PA
VOLUME 2			
Section I	:	Technical General Conditions	TC
Section II	:	Technical Specifications	TR
Section III	:	Drawings for Tendering	

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LOT III: DISMANTLING WORKS

VOLUME 1

			Symbol Mark
Section I	:	Instructions to Tenderers	A0, A1
Section II	:	Tender Form and Exhibits	A2
Section III	:	General Conditions of Contract	A3
Section IV	:	Schedule of Prices	A4
Section V	:	Technical General Conditions	TC
Section VI	:	Technical Specifications for Mechanical and Electrical Part	TS
Section VII	:	Technical Specifications for Civil and Architecture Work	TA
Section VIII	:	Drawings for Tendering	

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ATTACHMENT-3

DRAWING LIST FOR TENDERING I

The Drawings for Tendering are as follows.

1. Lot I

GENERAL

WGT-1001	General	Symbol Mark List and Device Function Number-1
		Symbol Mark List and Device Function Number-2
		Symbol Mark List and Device Function Number-3
1002	Ditto	Abbreviation List-1
		Abbreviation List-2
		Abbreviation List-3
		Abbreviation List-4
1003	Schedule	Schedule of implementation
WAT-1001	Site Layout	Site Layout Plan
1002	Ditto	Interface Between Existing and Planned Site Layout
WGT-1101	Main Powerhouse	General Arrangement -Ground Floor-
1102	Ditto	General Arrangement -Mezzanine Floor-
1103	Ditto	General Arrangement -Operation Floor-
1104	Ditto	General Arrangement -4TH Floor-
1105	Ditto	General Arrangement -5TH Floor-
1106	Ditto	General Arrangement -Section-

MECHANICAL

WMT-1001	Flow Diagram	Main Steam and Feed Water System
1002	Ditto	Cooling Water System
1003	Ditto	Auxiliary Steam System
1004	Ditto	Plant Water System
1005	Ditto	Fire Water System

1006	Ditto	Fuel Oil System
1007	Ditto	Drainage and Waste Water System
1008	Ditto	Instrument and Service Air System
1009	Ditto	Washing Water System
1010	Ditto	Chemical Feed and Sampling Rack System
1011	Ditto	Turbine Lubricating Oil System
1012	Ditto	Turbine Gland Steam Seal System
1013	Ditto	Boiler Drain and vent System
1014	Ditto	Flue Gas and Air System
1015	Ditto	Chlorination System (Seawater Electrolysis Method)
1016	Ditto	Dry Chemical System
1017	Ditto	Water Treatment System
WMT-1101	Heat Balance	Turbine Cycle Heat Balance, ECR (Typical)
WMT-1201	Auxiliary Arrangement	Arrangement of Laboratory
1202	Ditto	Arrangement of Machine Shop Equipment
1203	Ditto	Arrangement of Water Treatment Equipment & Control Room and Chlorination Equipment & Control Room
1204	Ditto	Arrangement of Heavy Oil Service Tank Area, Raw Water Pretreatment & Drinking Water Equipment Area and Chemical Storage Tank Area
1205	Ditto	Arrangement of Waste Water Equipment and Chlorination Feed Water Pump Pit
1206	Ditto	Arrangement of CW Pump and Screen Area
WMT-1301	Piping Layout	Yard Piping Layout-1
1302	Ditto	Yard Piping Layout-2
1303	Ditto	Piping Layout of Plant Water Equipment Yard
1304	Ditto	Piping Layout of Heavy Oil Storage Tank Yard
1305	Ditto	Piping Layout of House Boiler, Raw Water Pretreatment and Unit 2 Heavy Oil Service Tank Yard
1306	Ditto	Yard Drainage Layout

1307	Ditto	Drainage Piping Layout of Units 1 and 2 Main Powerhouse
WMT-1401	Standard	Recommended Weld End Preparation
1402	Ditto	Hanger and Support for Piping
1403	Ditto	Penetration Scheme for Pipe Line on Floor, Wall and Roof
WIT -1001	Control	Conceptual Diagram of Control System
1002	Ditto	Arrangement of BTG Board
1003	Ditto	Arrangement of Auxiliary Control Panel

ELECTRICAL

WET-1001		Key Single Line Diagram
1002		Protection and Metering Single Line Diagram
WET-1101		Skelton of Paging System
WET-1201		Standard Cable Tray-1
WET-1202		Standard Cable Tray-2
1203		Standard Cable Tray-3
WET-1204		Standard Piping Scheme
WET-2001		Conceptional Flow Diagram of H_2 Gas Seal Oil System
2002		Conceptional Flow Diagram of H2 Gas Generating System and Purging System

ARCHITECTURAL

WAT-1101	Main Powerhouse Architectural	Ground Floor Plan
1102	Ditto	Mezzanine Floor Plan
1103	Ditto	Operating Floor Plan
1104	Ditto	Forth Floor Plan

1105	Ditto	Crane Level & Low Roof Plan
1106	Ditto	Deaerator Platform & High Roof Plan
1107	Ditto	West & South Elevations
1108	Ditto	East & North Elevations
1109	Ditto	Sections
1110	Ditto	Detailed Building Sections
1111	Ditto	Finish Schedule
1112	Ditto	Door, Window & Louver Schedule
WAT-1201	Main Powerhouse	Piling Plan & Detail
1202	Ditto	Mat Foundation Reinforcing Plan
1203	Ditto	Mat Foundation Reinforcing Sections
1204	Ditto	Anchor Bolts Location Plan & Base Plates Details
1205	Ditto	Mezzanine Floor Framing Plan
1206	Ditto	Operation Floor Framing Plan
1207	Ditto	Fourth Floor Framing Plan
1208	Ditto	Low roof & Crane Level Framing Plan
1209	Ditto	Deaerator Platform & High Roof Framing Plan
1210	Ditto	Structural Elevations Sht-1
1211	Ditto	Structural Elevations Sht-2
1212	Ditto	Structural Elevations Sht-3
1213	Ditto	Structural Elevations Sht-4
1214	Ditto	Column Schedule
WAT-1215	Ditto	Wind Column & Girt Elevations Sht-1
1216	Ditto	Wind Column & Girt Elevations Sht-2
1217	Ditto	Detailed Structural Elevation
1218	Ditto	Reinforcement Standard
1219	Ditto	Transformer Yard Foundation
WAT-1301	Main Powerhouse Plumbing Equipment	Piping Skeleton, Legend
1302	Ditto	Sanitary Fixtures Schedule
1303	Ditto	Ground, Mezzanine, Cable Treatment, Operating & Fourth Floor Plan
1304	Ditto	Crane Rail & Low Roof, High Roof Floor Plan
1305	Ditto	Detailed Plan

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1306	Ditto	Schematic Diagram
1307	Main Powerhouse A/C & Ventilation	Equipment Schedule
1308	Ditto	Ducting and Piping Skeleton
1309	Ditto	Mezzanine, Cable Treatment, Operating & Fourth Floor Plan
1310	Ditto	Crane Rail & Low Roof Floor Plans
1311	Ditto	High Roof Plan
1312	Ditto	Air Conditioning machine Room Detail
1313	Ditto	Automatic Control & Secondary Wiring Floor Plans
1314	Ditto	Automatic Control & Secondary Wiring Low Roof Plans
1315	Ditto	Automatic Control & Secondary Wiring High Roof Plans
1316	Ditto	Automatic Control System Diagram
1317	Ditto	Secondary Wiring System (1)
1318	Ditto	Secondary Wiring System (2)
WAT-1401	Stack	Architectural and Structural Drawing
1402	Ditto	Electrical Drawing
WAT-1501	Administration Building Architectural	Ground, First, Second Third & Roof Plans
1502	Ditto	Elevations & Sections
1503	Ditto	Detailed Building Sections
1504	Ditto	Detailed Partial Plans & Sections
1505	Ditto	Finish Schedule
1506	Ditto	Door, Window & Louver Key Plan
1507	Ditto	Door, Window & Louver Schedule
WAT-1508	Administration Building Structural	Structural Drawing Sht-1
1509	Ditto	Structural Drawing Sht-2
1510	Ditto	Structural Drawing Sht-3
1511	Ditto	Structural Drawing Sht-4

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WAT-1520	Administration Building Plumbing Equipment	Piping Skeleton, Legend
1521	Ditto	Sanitary Fixtures Schedule
1522	Ditto	Ground, First & Second Floor Plans
1523	Ditto	Third, Roof & High Roof Floor Plans
1524	Ditto	Detailed Plans
1525	Ditto	Schematic Diagram
1526	Administration Building A/C and Ventilation	Equipment Schedule
1527	Ditto	Ducting and Piping Skeleton
1528	Ditto	Ground, First & Second Floor Plans
1529	Ditto	Third & Roof Floor Plans
1530	Ditto	Air Conditioning Machine Room Detailed Plan
1531	Administration Building Automatic Control & Secondary Wiring	Ground, First & Second Floor Plans
1532	Ditto	Third & Roof Floor Plans
1533	Ditto	Automatic Control System Diagram
1534	Ditto	Secondary Wiring Diagram
WAT-1605	Auxiliary Buildings Water Treatment Control Room	Architectural Drawing Sht-1
1606	Ditto	Architectural Drawing Sht-2
1607	Ditto	Structural Drawing Sht-1
1608	Ditto	Structural Drawing Sht-2
1609	Auxiliary Buildings	Warehouse Sht-1
1610	Ditto	Warehouse Sht-2
1611	Ditto	Chlorination Equip Area & fuel Oil Transfer Pump Area

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1612	Auxiliary Buildings & Outdoor Equip. Fnds.	Fuel Oil Pump & Heater Area, Fuel Oil Service Tank, Flue Gas Duct Foundation
1613	Auxiliary Buildings	Guard House, H2 Gas Generation Equip. Room
1614	Auxiliary Buildings & Outdoor Equip. Fnds.	Structural Drawing (Common for WAT-1611 --- 1613)
WAT-1617	Outdoor Equip. Funds.	Turbine Oil Storage Tank
WAT-1623	Water Treatment Control Room	Plumbing & Sanitary Fixtures
1624	Ditto	A/C and Ventilation
1625	Ditto	A/C and Ventilation
1626	Warehouse	Ventilation
1627	Ditto	Ventilation
1628	Chlorination Equip. & Control Room	Ventilation
1629	Ditto	Ventilation
1630	Guard House	Plumbing & Sanitation Fixtures
1631	Ditto	A/C & Ventilation
1632	Ditto	A/C & Ventilation

CIVIL

WCT-1001	Sea Water Depth Infront of Outlet-1
1002	Sea Water Depth Infront of Outlet-2
WCT-1101	Cooling Water Way
1102	Intake Open Channel
1103	Pump Pit-1
1004	Pump Pit-2
1005	Pump Pit-3
1106	Discharge Tunnel-1

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1107	Discharge Tunnel-2
1108	Outlet
WCT-1201	Outdoor Pipe Support Foundation-1
1202	Outdoor Pipe Support Foundation-1
1203	Chlorination Feed Water Pump Pit
1204	Raw Water Receiving and Drinking Water Equipment Foundation
1205	Raw Water, Demineralized Water and Make-up Water Tank Foundation
1206	Waste Water Treatment Facilities-1
1207	Waste Water Treatment Facilities-2
1208	Waste Water Treatment Facilities-3
1209	Cable Duct Foundation-1
1210	Cable Duct Foundation-2
1211	Cable Duct Foundation-3
1212	Other Foundation-1
1213	Other Foundation-2
1214	Read and Drainage System

2. LOT IIA

GENERAL

WGT-1103	Schedule	Schedule of Implementation
WAT-1001	Site Layout	Site Layout Plan
1002	Ditto	Interface Between Existing and Planned Site Layout

ELECTRICAL

WET-1001		West Wharf Substation Key Single Line Diagram
1002		West Wharf Substation Protection and Metering Single Line Diagram
1003		West Wharf Substation Arrangement of Substation
WET-1101		Baldia Grid Station 220kV Single Line Diagram
1102		Baldia Grid Station 220kV GIS Building Layout (Plan)
1103		Baldia Grid Station 220kV GIS Building Layout (Section)
1104		Baldia Grid Station Control Building
WET-1201		Standard Cable Tray-1
1202		Standard Cable Tray-2
1203		Standard Cable Tray-3
1204		Standard Piping Scheme

ARCHITECTURAL

WAT-1601	Substation Area	Architectural Drawing Sht-1
1602	Ditto	Architectural Drawing Sht-2
1603	Ditto	Structural Drawing Sht-1
1604a	Ditto	Structural Drawing Sht-2
1604b	Ditto	Transformer Yard Foundation

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WAT-1615	Grid Station Baldia	Architectural Drawing
1616	Ditto	Structural Drawing
WAT-1618	Substation	Plumbing
1619	Ditto	A/C and Ventilation
1620	Ditto	A/C and Ventilation
WAT-1621	Grid Station Baldia	Ventilation
1622	Ditto	Ventilation

UNDER GROUND TONNEL

WST-4001	Rout Plan (Plane)
4002	Rout Plan (Vertical)
4003	B.P. & Standard Section
4004	No. 1, No. 2 Man-Hole
4005	Turning Points
4006	Diverging Facility (1)
4007	Diverging Facility (2)
4008	No. 1 Ventilation (1)
4009	No. 1 Ventilation (2)
4010	No. 2 Ventilation

3. Lot IIB

Drawing No.	Title of Drawing
WLT-1001	Route Map
1002	Boring Point and Boring Log
1101	Skeleton of Tower (1)
1102	Skeleton of Tower (2)
1103	Skeleton of Tower (3)
1104	Configulation at the Place of Tower No. 1
1105	Plan at the Place of Tower No. 1
1106	Arrangement of 220 kV Incoming Lines at Tower No. 1
WLT-1201	220 kV V-Suspension Insulator String
1202	220 kV Single Tension Insulator String
1203	220 kV Double Tension Insulator String
1204	220 kV Jumper Support Insulator String
1205	132 kV Single Suspension Insulator String
1206	132 kV Single Tension Insulator String
1207	132 kV Double Tension Insulator String
1208	132 kV Jumper Support Insulator String
1209	132 kV Tie down Insulator String
1210	Fog Type Suspension Insulator
WLT-1301	Suspension Clamp for ACSR/AS 330 MM^2
1302	Suspension Clamp for ACSR/AS 680 MM^2
1303	Suspension Clamp for OPGW
1304	Tension Clamp for ACSR/AS
1305	Tension Clamp for OPGW
1306	Preformed Armor Rods
1307	Mid Span Joint
1308	Repair Sleeve
1309	T-Sleeve
1310	Double Torsioal Damper
1311	Spacer for ACSR/AS 330 MM^2

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WLT-1401	Earthing Clamp for OPGW
1402	Fixing Clamp for OPGW (1)
1403	Fixing Clamp for OPGW (2)
1404	Joint Box for OPGW 190/90 MM^2
1405	Terminal Box for OPGW 190/90 MM^2
WLT-1501	Danger Plate and Number Plate
1502	Anti-climbing Device
1503	Grounding Device
1504	Stringing Block for OPGW
1505	Stub Setting Template

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4. LOT III

REFERENCE DRAWINGS FOR DISMANTRING WORKS

The attached drawings were made by the KULJIAN CO. at the time of construction of the existing "B' and "BX" Station.

These drawings should be used as reference data for the dismantling works to be carried out by the Contractor of Lot III.

(1) Owner's Drawings

WAT-1002 Interface Between Existing and Planned Site Layout

(2) Reference Drawings

a) Layout and Diagram

General Layout of "A"B"&BX" STNS.

Karachi B P. St Rohrschema Pipework Diagram ("B" St.)

Single Line Flow Diagram Steam, Condensate, Turbine Oil, Air, Chem. Feed & Water ("BX" St.)

Combined Fuel Oil, Natural Gas and Steam Feeding System for "A"B&BX" Stations.

b) For "B" Station

Integral-Furnace-Boiler (Sht-1)

Integral-Furnace-Boiler (Sht-2)

Lubricating Oil system

Steelwork for Turbine House Plan at Tie Level of Turbine House

Steelwork for Turbine House Side Elevations (Sheet No. 1)

c) For "BX" Station

Cross Section, Key Plan & Plo Plan

Machine Location Plan (Sheet 1 of 2)

Machine Location Plan (Sheet 2 of 2)

Main Steam, Extraction steam, Auxiliary Steam and Vent Piping Plans and Sections

O.P. Suct. & Disch, Condensate, Cond. Air Piping Plans, Sections & Elevation

Circulating Water Piping Plans and Sections

Instrument Panels

Giat Elevations and Bracing

Structural Cross Sections

Single Line diagram

Conduit Plan Ground and Mezzanine Floors

Electrical Control Board