No. 35

THE ISLAMIC REPUBLIC OF PAKISTAN

DETAILED DESIGN STUDY
ON
WEST WHARF
THERMAL POWER PLANT PROJECT

FINAL REPORT-II

LOT I (VOLUME 3)

JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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VOLUME 3 TECHNICAL SPECIFICATION

PART I

SECTION I

TECHNICAL GENERAL CONDITIONS

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PART I

SECTION I

TECHNICAL GENERAL CONDITIONS

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PART I

SECTION I. TECHNICAL GENERAL CONDITIONS

1. INTENT

(1) The Technical General Conditions state the specific minimum requirements for design, storage, erection, test, commissioning, safety, etc., for the West Wharf Thermal Power Station Units 1 and 2.

The Technical General Conditions, together with the applicable Technical Specifications plus the Instruction to Tenderers, the Tender and Appendices, the Conditions of Contract, the Conditions of Particular Applications and the Drawings for Tendering shall form the Tender Documents which will ultimately become a part of the Contract between the Owner and the successful Tenderer.

(2) This Specification and the Drawings for Tendering show the Owner's basic design requirements. Therefore, the Contractor shall carry out the design in conformity with the requirements specified.

The Contractor's reliance thereon shall not relieve the Contractor nor its subcontractors of their responsibilities for meeting the performance and availability guarantees defined herein after and in the Contract.

In a case that the Contractor requires to revise parts of the Owner's basic requirement, they shall submit the explanation, calculations, drawings, etc., to the Owner and the Engineer for approval.

2. DESCRIPTION OF THE TECHNICAL SPECIFICATIONS

The technical specification for the scope of works under the Lot I Tender Documents shall be covered in Volume 3 as follows:

VOLUME 3

PART I TECHNICAL GENERAL CONDITIONS

SECTION I TECHNICAL GENERAL CONDITIONS

SECTION II DESIGN STANDARDS

VOLUME 4

PART II TECHNICAL SPECIFICATIONS

SECTION I GENERAL SPECIFICATIONS

SECTION II STEAM GENERATOR AND AUXILIARY EQUIPMENT

SECTION III STEAM TURBINE AND AUXILIARY EQUIPMENT

SECTION IV ANCILLARY SYSTEM AND COMMON AUXILIARY EQUIPMENT

SECTION V GENERATOR AND ELECTRICAL EQUIPMENT

SECTION VI PLANT COMPUTER SYSTEM

Specifications for the design, manufacture, supply, fabrication, transportation, installation, testing, and commissioning of all equipment and materials for the Power Plant, including the furnishing of all necessary plant tools, material, labor, equipment, storage and transportation for performing all operation in connection with the complete installation thereof as covered and/or specified in the Specifications, and by the Drawings for Tendering.

VOLUME 5

PART III CIVIL AND ARCHITECTURAL TECHNICAL SPECIFICATIONS

SECTION I GENERAL SPECIFICATIONS

SECTION II TECHNICAL SPECIFICATIONS

General Specifications and Technical Specifications for the design, manufacture, supply, fabrication, transportation, installation, technical supervision and advice of construction, testing and commissioning of equipment for the civil, architectural and structural works as well as building service facilities of the Plant, and including the material, labor, equipment, storage and transportation for performing all operations in connection with the complete erection and installation thereof as covered in these Specifications and in the Drawings for Tendering.

VOLUME 6 DRAWINGS FOR TENDERING

Site layout, flow diagrams, one line diagrams, standard drawings and other drawings.

3. PARTICULAR SITE CONDITIONS

The West Wharf Thermal Power Station Project is a redevelopment and innovation project of the old power station, that is, the existing West Wharf Thermal Power Station, calling for the construction of 2 units of 200 MW oil fired thermal power generating units.

The existing West Wharf Thermal Power Station is located in the West Wharf area facing Karachi Bay.

This site area is located near the load center of Karachi, and its north side is adjacent to the Caltex oil terminal.

The west side faces Dockyard Road, with land owned by the Pakistan Navy on the south side of this road.

Further on toward the west side of this road are found the Pakistan Oxygen & Acetylene Co., Ltd., and the Karachi Shipyard & Engineering Works Ltd. (KSY).

The east side border of this site faces a wharf, belonging to Karachi Port Trust (KPT) and has a width of approximately 150 m.

Found within a total site area of about 37,000 m^2 is the power station comprising Station "A", "B" and "BX".

However, Station "A" had been decommissioned and almost all equipment and machinery were dismantled. Only a few vacant buildings and machine foundations remain.

In 1987, "B" Station (15 MW x 2) had also been decommissioned, and only the "BX" Station is presently operating.

The "BX" Station (33 MW x 2) plays an important role in the KESC system. It generates power and maintains system stability, supplying power to the nearby city center and the West Wharf area via 66 kV transmission lines and an 11 kV distribution system.

The project envisages construction of 2 sets of 200 MW oil-fired thermal power generating units in a narrow (about 37,000 m^2) rectangular area while maintaining the existing facilities in operation. For this reason construction work prodecures must be carefully studied in order to avoid any interference or trouble between the existing facilities and the structures and facilities to be newly constructed.

It has been pointed out that it is desirable to terminate operation of the existing "BX" Station in order to implement the West Wharf Thermal Power Station Project as scheduled and without any undue difficulty. This can be achieved by decommissioning and dismantling of the "BX" Station during the construction period of the new units. However, as the "BX" Station can not be decommissioned and dismantled until the middle of 1992, the construction work of the first unit should be started and executed while the "BX" Station is still in operation.

Also, construction work should be carried out with extreme caution so as not to interfere with the operation of the "BX" Station and the related transmission and distribution facilities.

Furthermore, this project calls for construction of not only power generating facilities, but also other related facilities which must be constructed outside of the power station site, such as those constructed inside KPT and KSY premises as well as those across or along the public road.

These construction items are roughly outlined in the following descriptions.

(1) Cooling Water Ways

Cooling water intake facilities shall be furnished re-utilizing the existing water ways in the Karachi Port Trust (KPT) premises located on the east side of the power plant.

There are two existing intake cooling water ways:

one for the "BX" Station, which is still in operation, the other is the 10 foot square culvert, which was constructed about 1970 intended for future use but not yet used.

Necessary rehabilitation work and installation of new facilities (screens, etc.) shall be carried out within the premises of KPT as permitted.

Therefore, the work must be performed with strict control and according to the regulations of KPT without any obstruction or hindrance to KPT activities.

The cooling water discharge way shall be constructed within the Karachi Shipyard (KSY) premises, which is located on the west side of the power station.

The discharge pipe(s) from the condenser shall be led to a concrete culvert within the power station site. The culvert will then run outwards to the KSY premissis via Dockyard Road going west wards along the boundary wall of the Naval base, and finally to the discharge point of the extention line at the existing KSY quay.

Some sections of the cooling water discharge way are to be constructed under Dockyard Road, and there are several pipe lines (water, oil and gas), power and communication cable lines, etc., burried in these areas.

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Therefore, the construction work shall be conducted and performed in due consideration of the safty and avoidance of damage to the existing installations, structures, facilities, as well as avoidance of disruption of public activities.

(2) Fuel Supply System

Fuel heavy oil will be supplied from the PSO (Pakistan State Oil Co.'s) oil storage yard in Keamari, which is located about 5 km away from the West Wharf Power Station, via oil pipe line(s) and received by the two existing receiving oil tanks of PSO, each having a capacity of 2,500 kl.

Fuel oil shall be taken from these tanks and sent to the service tanks of each unit by oil transfer pumps. This system shall be included in the scope of supply of LOT I and shall be provided by the Contractor. To ensure the reliable supply of fuel oil, another route will be utilized via the CALTEX facilities.

There is a CALTEX oil storage yard located on the north side of and adjacent to the site area.

Fuel oil will be supplied separately from these facilities to the above cited service oil tanks.

Necessary connections with appurtenances to receive the heavy oil shall be provided by the Contractor.

(3) Temporary Fuel Supply Facilities

The existing "BX" Station will be continuously operated during a certain period of the unit 1 construction schedule.

In order to supply natural gas to the "BX" Station as temporary fuel, the existing gas station shall remain until the "BX"

Station is decommissioned.

After the "BX" Station is decommissioned, the existing natural gas supply system shall be modified by LOT I contractor in order to use the system as auxiliary fuel supply for the project. This natural gas will be used for boiler start up, from the ignition stage up to the house load, and for the house boiler. The modification of the existing natural gas system includes pipeline simplification so as to enable easier operation and ensure greater safety.

(4) Substations Inside the Power Station Area

In the present West Wharf Thermal Power Station, there exists a 66 kV substation and an 11 kV grid station (distribution facilities).

The 66 kV substation comprises an outdoor switchyard and an indoor switchyard, and is connected inside of the power station to the tertiary wounded transformers of the "BX" Station and, to the 11 kV grid station.

These 66 kV substations are connected with four (4) transmission lines, which extend to Queens Road, Old Town, Mauripur and the Site grid stations.

In the early stage of the construction period of the project, the "BX" Station should be operated in order to supply power and maintain stability of the KESC system as previously mentioned. In order to shutdown the "BX" Station, a sufficient supply of power should be fed to this station from outside to enable stable power distribution through the 11 kV distribution system. This can be achieved by two (2) methods.

One is to feed power via the existing 66 kV transmission lines and the other is to feed power via the newly constructed 220/132 kV transmission and substation system at the time of completion around the middle of 1992.

Therefore, early commissionning of the new 220 kV transmission line and the 220/132 kV substation facilities is highly important.

However, to start construction of the new 220/132 kV substation, it is necessary to remove the 66 kV outdoor switchyard located on the west side of the indoor switchyard, so as to obtain necessary space for the new substation.

The replacement of the 66 kV outdoor switchyard is not included in the scope of works of this project, but the construction work of the new 220/132 kV substation shall be performed by the Contractor of Lot II A.

The Lot I Contractor shall perform their construction work and shall coordinate replacement work of the 66 kV outdoor switchyard and construction work of the new substation facilities, by exercising full care as to the safety of the works.

The 66 kV transmission lines and the existing 66 kV switchyard shall be left intact so long as they are necessary.

As the 66 kV switchyard is operated from the control room located in the existing administration building, the existing administration building will remain until the control facilities will be shifted to near the indoor switchyard for temporal use. (This shifting work is not included in the scope of Lot I)

The decommissioning date of the 66 kV transmission and switchyard facilities has not yet been decided.

As for the 11 kV grid station, it must remain as it is throughout the entire construction period and even after completion of the project for the purpose of distributing power to the local area around of the West Wharf Thermal Power Station.

The Lot I Contractor shall prepare the construction method, in full awareness of this condition, and shall take whatever measures are necessary to keep the completion of the project within the contracted schedule. In no case shall any damage or harm to operation of the existing 66 kV transmission facilities and 11 kV distribution system be allowed.

As it is unavoidable that the construction work of the project shall be faced with many obstructions and interferences to not only the existing facilities but also the new equipment and facilities included in Lot I, Lot II A, B and Lot III, the tenderer(s) shall prepare a fully detailed "Construction Sequence" which showing all necessary construction sequences, indicating the order of priority of each work among the affected construction items.

This Construction Sequence shall be a part of the Tender Document, and shall be submitted for tendering.

Note that it shall be one of the valuable documents for evaluation of tenderers.

4. SCOPE OF WORKS AMONG CONTRACTOR OF LOT I AND OTHERS

The Contractor of Lot I shall carry out the scope of works as described in the following. The detailed scope of work is specified in Part I, II and III of this Specification.

Basic conceptional requirements are provided and stated in the General Specifications, Technical Specifications and the Drawigns for Tendering .

The basic design and detailed design shall be carried out by the Contractor of Lot I, and detailed design drawings, data, calculations and shop and working drawings for construction shall be drawn up by the Contractor of Lot I, who shall submit these drawings and documents to the Owner and the Engineer for approval.

The Contractor of Lot I shall carry out all necessary works for the purpose of compatibity with the existing equipment and facilities (including existing buildings which are remaining during the construction work of this project and protection works for these equipment and facilities.)

The Contractor of Lot I shall provide all works such as plans, designs, manufacture, fabrication, supply, transportation, storage, installation, erection, testing, commissioning and operation/ maintenance guidance (advise) for all materials, equipment and facilities of the Plant.

Concerning the works of civil, architectural and structural design in the Plant, the Contractor of Lot I shall provide plans and designs, and shall assume all responsibilities of the Plant including supervision of the civil, architectural and structural

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works. As the civil, architectural and structural works are also included in the scope of Lot I, the Contractor of Lot I shall execute the all necessary erection installation and construction of civil, as well as architectural/structural works for the Plant concerned.

Major civil works to be performed by the Lot I Contractor are indicated as follows.

(1) Entire works for main power house, stack and auxiliary buildings.

(2) Reinforced concrete works for indoor equipment foundations.

(3) Entire works for reinforced concrete tanks, pits, oil separators, chambers, ponds, cable trenchs and troughs, manholes, culverts and other reinforced concrete structures.

(4) Entire works for foundations of main transformers, auxiliary transformers, starting transformer pipe racks and other outdoor equipment.

(5) Entire works for intake structure, rehabilitation works of the buried intake cooling water ways and construction works for the discharge cooling water ways.

(6) Removal work of the existing piles.

(7) All other necessary civil, architectural and structural work.

5. TERMINAL POINTS AMONG CONTRACTORS OF EACH LOT

The Owner will request the following items of works and services under separate contracts. However, the Contractor of Lot I shall coordinate his works with the works and services executed by other separate contractors.

(1) 220/132 kV Substation and Extension of Bardia Grid Station

(Contractor of Lot IIA)

- o 220/132 kV substation inside the power station, including civil and architectural works
- o 220 kV extension bays in the Baldia Grid Station, including civil and architectural works
- o Underground cable with tunnel between West Wharf Thermal Power Station to No. 1 transmission tower

(2) 220 kV Transmission Line Facilities

(Contractor of Lot IIB)

- o 220 kV transmission line facilities from No. 1 transmission tower to Baldia Grid Station, including transmission towers and related facilities

(3) Dismantling Work of Existing Equipment and Facilities

(Contractor of Lot III)

- o Dismantling of the existing equipment, buildings, foundations, etc., unless otherwise specified
- o Site preparation work, cleaning and leveling work of the site area

Detailed terminal points among separate lots shall comprise, but not be limited to, the following.

5.1 TERMINAL POINTS BETWEEN CONTRACTORS OF LOT I AND LOT IIA

(1) Cable and wire

The material supply, laying and termination work of cable and the tests for the following circuits shall be provided and carried out by the Contractor of Lot I.

(a) Remote control circuit of 220 kV, generator circuit breaker and associated 220 kV isolator.

(b) Remote control circuit of 132 kV starting transformer circuit breaker and associated 132 kV isolator.

(c) Remote indication circuit of substation monitoring panel between substation control panel and substation monitoring panel.

(d) 400 V emergency power circuit between 1-3, 400 V control center and substation battery charger.

(e) 400 V power circuit between common-1 control center and substation 400 V control center.

(f) Communication circuit between transducer panel of power station and RTU in the substation control room.

(g) Telephone circuit between central control room and substation control room.

(h) Paging system circuit between amplifier panel in the electrical and control equipment room and terminal box in the substation.

(i) Clock system circuit between master clock in the power station and slave clock in the substation.

(j) The material supply and connection work for the interconnection points of grounding wire between main

power house area and substation area shall be provided and carried out by the Contractor of Lot I.

(2) Paging

The material supply, installation of paging handsets, speakers and terminal boxes for the substation shall be provided and carried out by the Contractor of Lot I, and material supply, piping, cabling work shall be provided and carried out by the Contractor of Lot I.

(3) Clock system

The material supply, installation of the slave clock of the substation control room and wiring work shall be provided and carried out by the Contractor of Lot I.

(4) 132 kV CV cable

The material supply, connection work of 220 kV CV (XLPE) cable and 132 kV CV (XLPE) cable with 220 kV and 132 kV GIS respectively, shall be provided and carried out by the Contractor of Lot I.

(5) Fire protection system for new substation

Fire protection system for new substation shall consist of transformer spraying system and manual fire alarm service as described below.

(a) Transformer water spraying system to be installed by the Contractor of Lot IIA shall be supplied from temporary city water receiving piping using a temporary booster pump set.

This pipeline shall have a terminal valve on the connection end of the spray piping to be connected by the

Contractor of Lot I.

After the completion of fire water system, the connection work for the said piping shall be carried out by the Contractor of Lot I, and shall include installation of solenoid valves which shall be activated by an operation switch on the fire protection panel in the central control room.

(b) Manual fire alarm service by means of a fire alarm push button for new substation shall be provided by the Contractor of Lot I in order to systematize the fire protection system.

Fire alarm push button shall be mounted on the outside wall near the entrance, and the signal shall be transmitted to the fire protection panel.

(6) City water receiving piping

The Contractor of Lot IIA shall carry out dismantling work of the existing "B" Station discharge way and existing city water receiving piping located along the discharge way in order to construct the 132 kV and 220 kV substation.

However, the existing city water piping shall undergo no changes prior to the "BX" Station being dismantled.

Therefore, temporary city water receiving piping, to be constructed by the Contractor of Lot IIA, shall be provided from the boundary point to city water receiving tank. The portion of temporary piping located via the yard in back of the new substation construction area shall be installed as a permanent pipeline. This pipeline shall have terminal valves

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on both connection ends of the piping and shall provided with connection by the Contractor of Lot I.

The Contractor of Lot IIA shall connect the spray nozzle line of all substation transformers from the temporary city water receiving pipeline, including temporary booster pump installation. This piping shall also be used for sanitation purposes. After the completion of water supply system of power plant the connection work of necessary piping for the new substation shall be carried out by the Contractor of Lot I.

(7) Drainage and sanitary waste water discharge system

Permeation system of discharge and sanitary waste water of new substation shall be provided by the Contractor of Lot IIA before completion of Unit 2 site drainage system.

The Contractor of Lot I shall carry out the connection works of the said pipe terminals to the site drainage system after completion of site drainage system.

(8) Dismantling of existing discharge pipe

(a) As for the existing discharge pipes from "B" Station to the sea, the boundary point shall be at the boundary between the dismantling work area of Lot IIA and that of Lot I.

(b) The boundary line between Lot I and Lot IIA in "B" Station area shall be at the boundary between each dismantling area.

(c) The boundary point shall be at the boundary between the construction areas of the cable tunnels by the Contractor of Lot IIA and that of Lot I.

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The above mentioned terminal points shall, in principle, be the points to be designated by the Engineer at the site. The Contractor shall submit the actual working plan and schedule table to the Engineer for approval before the commencement of the work.

5.2 TERMINAL POINTS BETWEEN CONTRACTORS OF LOT I AND LOT III

(1) Site particulars

(a) The Contractor of Lot III shall completely dismantle the existing buried foundations, cables, conduits, pipes, etc., down to 3 meters below the ground level (EL + 4,800 mm), in accordance with the conditions of scope of works shown in the Owner's Tender Drawing "DISMANTLING WORKS".

(b) The ground level site condition transferred from the Lot III Contractor to the Lot I Contractor shall be EL + 3,800 m, except for the site boundary walls and the adjacent areas.

(c) After transfer of the site on the basis of the above condition, existing buried foundations, cables, conduits, pipes, etc., if any exist, below the specified level (EL + 1,800 mm) shall be dismantled by the Contractor of Lot I.

(d) Necessary site preparation work such as soil improvement, access roads, dewatering, etc., shall be done by the Contractor of Lot I.

(e) Temporary boundary wall and gates between Unit 1 area and Unit 2 area shall be provided by the Contractor of Lot III.

(2) Dismantling works

(a) UNIT 1 Area

All existing facilities, pipings, buildings, structures, foundations, cables, trees, shrubbery etc., in the Unit 1

area, except for C.W.pump house for "A" Station, discharge sump for "A" Station, a part of dike for PSO tanks and site boundary wall and gates, shall be dismantled by the Contractor of Lot III.

C.W. pump house for "A" Station, discharge sump for "A" Station, a part of the dike for PSO tanks and site boundary wall and gates of the above shall be dismantled by the Contractor of Lot I.

However, isolation work of discharge sump for "A" Station shall be done by the Contractor of Lot III.

(b) UNIT 2 Area

All existing facilities, pipings, buildings, structures, foundations, cables, trees, shrubbery etc., in the Unit 2 area, except for C.W. pump house and screen for "B" and "BX" Station, sewer sump and pumping station, site boundary wall and gates below the ground floor level including existing RCC piles of "B" and "BX" Station buildings, stacks and transformer yard foundations and existing outdoor switchyard area, shall be dismantled by the Contractor of Lot III.

C.W. pump house and screen for "B" and "BX" Stations, sewer sump and pumping station, site boundary wall and gates below the ground floor level including existing RCC pile of "B" and "BX" Station buildings, stacks and transformer yard foundations of the above, shall be dismantled by the Contractor of Lot-I.

Existing outdoor switchyard area shall be dismantled by

the Contractor of Lot IIA.

During dismantling work of "B" Station, temporary wall siding for the "BX" Station turbine house shall be provided by the Contractor of Lot-III.

(3) Isolation work of natural gas piping

Natural gas piping for the "A" Station shall be isolated before the "A" Station is dismantled by the Contractor of Lot III. The above work shall be carried out by the Contractor of Lot III from the shut off-valve located at the existing SUI Gas Station to the shut-off valve located at the nearby "A" Station power house.

Both isolation points shall be blind flanged so as to ensure greater safety for the dismantling work and Unit 1 construction. However, as the shut-off valve on the "A" Station side is located nearby, this valve must be blind flanged to the location outside the above dismantling work area of the "A" Station.

5.3 TERMINAL POINTS BETWEEN CONTRACTORS OF LOT IIA AND LOT IIB

The respective terminal points of the facilities provided under Lot II A and Lot II B shall be as follows. (See Fig. 5.3.1)

(1) 220 kV line

(a) The tension insulator string sets and the tension clamps for the ground wires at the gantry structures at tower No. 1 and the Baldia G/S shall be provided by the Contractor of Lot IIB.

(b) The plates on the gantry structures for tension sets of conductors and ground wires shall be provided by the Contractor of Lot IIA.

(c) Parallel groove clamps and lead conductors for the lightning arresters shall be provided by the Contractor of Lot IIB.

(d) The terminals of the lead conductors for the lightning arresters shall be provided by the Contractor of Lot IIA.

(e) The lead down OPGW, fixing clamps, rack and terminal box for OPGW to be mounted on the gantry structures shall be provided by the Contractor of Lot IIB.

(f) The connection work of optical fiber cable with OPGW shall be carried out by the Contractor of Lot IIB.

(2) 132 kV line

(a) The down conductors and insulator strings shall be provided by the Contractor of Lot IIB.

(b) Parallel groove clamps and lead conductors for lightning arresters shall be provided for under a separate contract.

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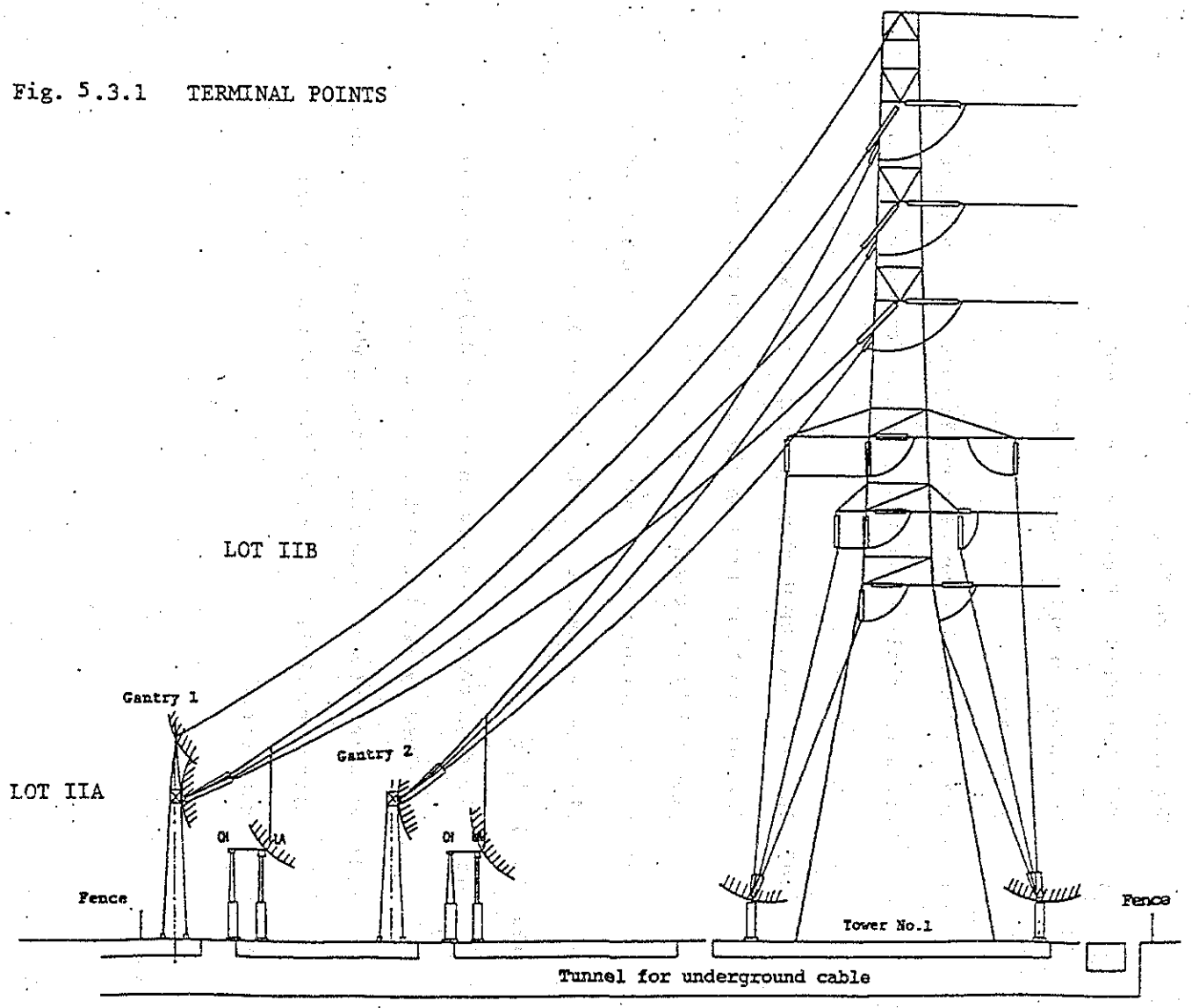
Fig. 5.3.1 TERMINAL POINTS



5.4 TERMINAL POINTS BETWEEN CONTRACTORS LOT IIA AND LOT III

(1) Dismantling works

(a) The works of the existing intake water pipes from the C.W. pump house end of the "B" and "BX" Stations up to a point in front of the existing 66 kV indoor substation shall be carried out by the Contractor of Lot III.

(b) The remaining pipes from in front of the existing 66 kV indoor substation to the "B" Station shall be dismantled by the Contractor of Lot IIA before commencement of civil works for the new 220/132 kV substation.

5.5 TERMINAL POINTS BETWEEN OWNER AND CONTRACTOR OF LOT IIA

(1) Existing 11 kV grid station

(a) The dismantling work of the existing 11 kV incoming cables shall be carried out by the Contractor of Lot IIA.

(b) The material supply and connection work of the new 11 kV CV (XLPE) cables with existing 11 kV switchgear shall be provided and carried out by the Contractor of Lot IIA under supervision by the Owner.

(c) The operation of existing switchgear with necessary information for respective stations and/or consumers will be carried out by the Owner.

(d) The material supply, installation work of the 11 kV current transformer (CTs) for transformers differential relay and material supply, laying, termination and test of control cable shall be provided and carried out by the Contractor Lot IIA.

(2) Existing 66 kV substation

(a) The shifting work of the existing 66 kV outdoor substation equipment, including associated cables and necessary operation panels, will be carried out by the Owner.

5.6 COMPATIBILITY WORKS AND PROTECTION WORKS FOR EXISTING EQUIPMENT AND FACILITIES

The Contractor of Lot I shall carry out all necessary re-adjustment works compatible with existing units as well as the protection works for the existing "BX" Station equipment and facilities related to the works of this Project.

Although detailed information for the above works is specified in the related section of the Tender Documents, the outline of compatibility works and protection works for the existing "BX" Station equipment shall, in principle, be as follows.

(1) General description

(a) Piping

- o Supply and installation of valves
- o Supply and installation of flanges
- o Supply and installation of insulation
- o Cutting and jointing from/to the existing pipes
- o Supply and installation of pipe supports and their foundations
- o Adjustment and re-routing of existing pipes
- o Execution of all necessary protection works for the existing equipment and facilities

(b) Panel

- o Supply and installation of instruments, switches, lamps, etc.
- o Supply and installation of cables and wires
- o Supply and installation of necessary panels
- o Execution of all necessary protection works for the existing equipment and facilities

(c) Pits and ponds

- o Chipping work, installation of equipment, conduits, etc.
- o Grouting and mortar finishing for the above
- o Execution of all necessary protection works for the existing equipment and facilities

(d) Trays and conduits

- o Supply and installation of trays and conduits
- o Adjustment and re-routing of existing trays and conduits
- o Execution of all necessary protection works for the existing equipment and facilities

(e) Equipment and facilities

- o Supply and installation of equipment and facilities
- o Execution of all necessary protection works for the existing equipment and facilities

(2) As a partition fence shall be installed between "BX" Station and construction area of the new power plant by the Contractor, all works to be carried out within the premises of the existing power station shall be carried out after obtaining approval from the Owner and the Engineer.

(3) All re-adjustment work which cannot be executed unless the existing units are shut down shall be carried out as concentrately as possible after obtaining approval from the Owner and the Engineer. All such works shall be completed within the specified work period.

In all cases, the period of shutting down of existing power station shall be made as short as possible.

(4) All appropriate protective and safety measures shall be taken regarding construction of the discharge cooling waterway so as not to cause any harmful effect on existing equipment of KSY (Karachi Ship Yard) or operation of any existing equipment.

(5) All appropriate protective and safety measures shall be taken regarding construction of the intake water open channel so as not to cause any harmful effect on the existing equipment of KPY (Karachi Port Trust) or operation of any existing equipment.

(6) All appropriate protective and safety measures shall be taken regarding construction of the waste water treatment system so as not to cause any harmful effect on the existing oil tank equipment or operation of any existing equipment.

(7) The Contractor shall be responsible for any damage or harm incurred to the existing property of the Owner, such as plant equipment, facilities, wharf, road, jetty, etc., during the execution of his works.

6. APPLICABLE STANDARDS AND CODES

(1) The equipment and materials shall be designed and constructed in accordance with the following acceptable standards, codes and regulations except where the requirements of these Specifications take precedence, in which case the requirements of these Specifications shall be followed.

The standards, codes and regulations to be applied shall, at the time of tender submittal, be in accordance with the latest revisions.

(2) Where the documents provide requirements for material or equipment by specifying a standard such as, for example, an item of the International Standard Organization, which has its origin in one country, it shall not be the intention to restrict the requirements solely to that standard or country. Other standards will be accepted provided that the requirements thereof, in the sole opinion of the Engineer, are at least equal to the requirements of the standards specified.

If the tenderer wishes to apply equivalent standards, codes and/or regulations of other authorities, the alternate standards, codes and/or regulations shall be equally acceptable provided that they in no way detract from the quality, safety, operability or durability of the equipment and materials furnished. However, when standards, codes and/or regulations other than those contained in the following list of "Applicable Standards and Codes" are offered by a tenderer, he shall propose them in the English language, so that a direct comparison can be made by the Engineer. If the proposed alternate standards, codes and/or regulations are

acceptable to the Owner and the Engineer, they shall be authorized by the Engineer in writing.

Codes & Standards

(a) Japanese, German, American, French, British standards and codes or equivalent.

(b) International standards and codes, or equivalent.

(c) Pakistani regulations.

(d) Standards of Karachi Electric Supply Corporation Ltd. (KESC)

The following list of "Applicable Standards" is provided only as an example of the required standards and codes. Other standards and codes not listed herein may be accepted upon fulfilment of the provisions of this Clause, if so deemed by the Owner or the Engineer.

Applicable Standards and Codes

(1) Japanese Industrial Standards (JIS)

(2) International Electrotechnical Commission (IEC)

(3) Japan Electric Manufacturers' Association Standards (JEM)

(4) Architectural Institute of Japan (AIJ)

- o Standards for Design of Steel Pile Foundation for Building
- o Standards for Calculation for Reinforced Concrete
- o Standards for Structural Design of Building Foundations
- o Standards for Design of Steel Structure

(5) Steam Table of Japan Society of Mechanical Engineers (JSME)

(6) American Association of States Highway Officials (AASHO)

(7) American Boiler Manufacturers Association (ABMA)

(8) American Concrete Institute (ACI)

(9) American Institute of Architects (AIA)

(10) American Institute of Steel Construction (AISC)

(11) American Iron and Steel Institute (AISI)

(12) American National Standards Institute (ANSI)

(13) American Petroleum Institute (API)

(14) American Society of Civil Engineers (ASCE)

(15) American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

(16) American Society of Mechanical Engineers (ASME)

(17) American Society of Testing Materials (ASTM)

(18) American Welding Society (AWS)

(19) American Water Works Association (AWWA)

(20) Cast Iron Soil Pipe Institute (CISPI)

(21) Edison Electric Institute (EEI)

(22) Electric Overhead Crane Institute (EOCI)

(23) Expansion Joint Manufacturers Association (EJMA)

(24) Federal Specifications and Standards (Fed Spec)

(25) Heat Exchange Institute (HEI)

(26) Hoist Manufacturers Institute (HMI)

(27) Hydraulic Institute (HI)

(28) Institute of Electrical and Electronic Engineers (IEEE)

(29) The Japanese Electrotechnical Committee (JEC)

(30) Illuminating Engineering Society (IES)

(31) Insulated Power Cable Engineers Association (IPCEA)

(32) Instrument Society of America (ISA)

(33) International Organization for Standardization (ISO)

(34) Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

(35) National Association of Corrosion Engineers (NACE)

(36) National Electrical Manufacturers Association (NEMA)

(37) National Fire Codes (NFC)

(38) National Insulation Manufacturers Association (NIMA)

(39) National Oil Fuel Institute (NOFI)

(40) Pipe Fabrication Institute (PFI)

(41) Japan Cable Maker Association Standards (JCS)

(42) Society of Automotive Engineers (SAE)

(43) Tubular Exchanger Manufacturers Association (TEMA)

(44) Valve Manufacturers Association (VMA)

(45) Air Moving and Conditioning Association (AMCA)

(46) Japanese Society of Civil Engineers:

- o Standard Specifications for Concrete
- o Recommendations for the Design and Construction of Prestressed Concrete

(47) Japan Highway Association:

- o Specifications for Manufacture of Steel Highway Bridge
- o Specifications for Welded Steel Highway Bridge
- o Recommendations for Cement Concrete Pavement

(48) The Watergate and Penstock Association:

- o Technical standards for watergates and Penstocks

(49) Japan Port and Harbor Association:

- o General specifications of port and Harbor Construction

(50) Basic Law for Environmental Pollution Control (Japan)

(51) Fire Defense Law (Japan)

(52) Explosives Control Law (Japan)

(53) Occupational Safety and Health Administration (OSHA)

(54) Building Standard Law (Japan)

(55) Building Standard Law Enforcement Code (Japan)

(56) Heating, Air Conditioning and Sanitary Standards (HASS)

(57) Pakistan Regulations

7. UNITS OF MEASUREMENT

(1) UNITS OF MEASUREMENT

In all correspondence, technical schedules, drawing and instrument scales, the following units shall be used:

Quantity	Name of Unit	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
	Minute	min
	Hour	h
Temperature	Degree Celsius	^{o}C
Temperature difference	Kelvin	K
Electric current	Ampere	A
Luminous intensity	Candela	cd
Area	Square meter	m^2
Volume	Cubic meter	m^3
	Liter	l
Force	Newton	N
Pressure (gauge)	Pascal	MPa g
Pressure (absolute)	Pascal	MPa a
Stress	Newton per square millimeter	N/mm^2
Velocity	Metre per second	m/s
Rotational speed	Revolutions per minute	rpm
Flow	Cubic meter per day	m^3/d
	Cubic meter per hour	m^3/h
	Kilogram per hour	kg/h

3-30

Quantity	Name of Unit	Symbol
	Litre per second	l/s
Density	Kilogram per cubic meter	kg/m^3
Torque, moment of Force	Newton meter	Nm
Work, energy or heat	Joule	J
Heat capacity, entropy	Jule per kelvin	J/K
Power, radiant flux	Watt	W
Thermal conductivity	Watt per meter kelvin	W/mK
Dynamic viscosity	Newton second per square meter	Ns/m^2
Kinematic viscosity	Square meter per second	m^2/s
Diffusion coefficient	Square meter per second	m^2/s
Surface tension	Newton per meter	N/m
Concentration	Parts per million	ppm
Electrical conductivity	Microsiemens per meter at 25°C	µS/m
	Microsiemens per centim at 25°C	µS/cm
Frequency	Hertz	Hz
Electric charge	Coulomb	C
Electric potential	Volt	V
Electric field strength	Volt per meter	V/m
Electric capacitance	Farad	F
Electric resistance	Ohm	Ω
Conductance	Siemens	S
Magnetic flux	Weber	Wb
Magnetic flux density	Tesla	T

3-37

Quantity	Name of Unit	Symbol
Magnetic field strength	Ampere per meter	A/m
Inductance	Henry	H
Luminous flux	Lumen	lm
Illuminance	Lux	lx
Thermal resistivity	Kelvin meter per watt	Km/W

(2) METRIC ENGINEERING SYSTEM OF UNITS

The Metric Engineering System of Units shall be the system used in view of its wide applicability to projects of this nature and the work involved.

3-38

8. SITE CONDITIONS

8.1 SUMMARY

Note that the climatic, oceanographic, etc., information given hereunder is intended only as design reference for the Contractor.

Description	Conditions
(1) Ambient temperature (Year 1975 - 1987)	
Maximum (Highest) (May 9, 1938)	47.8 °C
Maximum (Monthly Mean)	42.7 °C
High average (Yearly Mean)	36.4 °C
Low average (Yearly Mean)	16.6 °C
Minimum (Monthly Mean)	6.1 °C
Minimum (Lowest) (Jan. 21, 1934)	0 °C
(2) Relative humidity	
Maximum (Highest Monthly Mean)	85 %
Average (Yearly Mean at 5 A.M.)	73 %
Minimum (Lowest Monthly Mean)	62 %
(3) Atomospheric pressure	
Maximum (Highest Monthly Mean)	1016.1 mb
Maximum (Monthly Mean at 8 A.M.)	1017.2 mb
Minimum (Monthly Mean at 5 P.M.)	996.7 mb
Minimum (Lowest Monthly Mean)	997.5 mb
(4) Rainfall (Average figures for 1975 - 1984)	
Maximum (Monthly Mean)	100.1 mm/Month
Total Rain Fall (Yearly Mean)	265.2 mm/Year
Greatest Rainfall in a Day (Aug. 2, 1944)	152.4 mm/Day

Description	Conditions
Rainy Season	March through October and December

(5) Wind

Maximum Momentary Wind Velocity	Over 10 Beaufort (24.5 - 28.4 m/s and over)
Maximum Average Velocity (South West direction)	5.2 m/s
Wind Direction	SW in summer NW in winter NE during rainy season

(6) Sea water temperatures of Karachi Harbour

Surface Temperature (Maximum)	32.5°C
3 - 4 meter Deep Temperature (Maximum)	32.5°C
Temperature Range	18.5 to 32.5°C

(7) Bench mark and level

The Contractor shall lay out his work from bench mark of K.D.A (Karachi Development Authority) and shall be responsible for all measurements in connection with his work.

The Contractor shall, at his own expense, furnish all bench marks, stakes, templates, platform, equipment, and labor, including surveyors, that may be required in setting or laying out any part of the work.

The Contractor shall be held responsible for the proper execution of the work.

The levels indicated in the Drawings and Specification, in meter, are translated to Chart Datum, which is the same as the

Zero of the tidal predictions.

However, the basic datum of above bench mark are those of the Survey of Pakistan, which has it's zero point at "Mean sea level" and which is 5.18 feet (1.579 meters) higher than the Zero of the tidal predictions.

No. 47 bench mark of K.D.A near power station is located on Dockyard Road near Glaxso Laboratory.

Therefore, level of NO. 47 bench mark (R.L=3.581m) becomes EL + 5.160m.

(8) Sea water level

a) The Highest High Water Level (The Highest Astronomical Tide is adopted as design H.H.W.L)

H.H.W.L = E.L + 3.23 m

b) Mean Sea Water Level

M.S.L = E.L + 1.64 m

c) The Lowest Low Water Level (The lowest Astronomical Tide is adopted as design L.L.W.L)

L.L.W.L = E.L - 0.43 m

(9) Ground level (G.L)

G.L. = E.L + 4.80 m

(10) Sea water analysis

Refer to the Table 8-1 "Chemical Analysis of Sea Water (Karachi Port)" attached.

(11) Raw water analysis

Refer to the Table 8-2 "Raw Water Analysis" attached.

Table 8-1 Chemical Analysis of Sea Water

(Karachi Port)

		SAMPLE 1 ON HIGH TIDE	SAMPLE 2 ON MEDIUM TIDE	SAMPLE 3 ON LOW TIDE
1.	PH	6.85	6.75	6.82
2.	CHLORINE	19,915 PPM	19,536 PPM	19,433 PPM
3.	SULPHATE	2,829 "	2,815 "	2,770 "
4.	CALCIUM	357 "	361 "	353 "
5.	MAGNESIUM	1,372 "	1,372 "	1,378 "
6.	SODIUM	9,250 "	9,250 "	9,250 "
7.	POTASSIUM	285 "	285 "	285 "
8.	AMMONIA	0.55 "	0.5 "	0.61 "
9.	IRON	0.04 "	0.04 "	0.05 "
10.	ALUMINIUM	N.D.	N.D.	N.D.
11.	MANGANESE	0.02 "	0.025 "	0.025 "
12.	CHEMICAL OXYGEN DEMAND AS KMNO 4	1.3 "	1.0 "	1.1 "
13.	HYDROCARBON (OIL)	1.2 "	1.3 "	0.3 "
14.	ORGANIC MATTER IN TDS (CARBON ORANIC DEPOSIT)	2,921 "	2,638 "	2,656 "
15.	FLOURIDES	0.9 "	0.9 "	0.9 "
16.	COBALT	N.D.	N.D.	N.D.
17.	COPPER	N.D.	N.D.	N.D.
18.	NICKEL	0.03 "	0.04 "	0.05 "
19.	TOTAL HARDNESS AS CACO 3	6,530 "	6,540 "	6,550 "
20.	TOTAL DISSOLVED SOLIDS (TDS)	39,794 "	39,218 "	38,840 "

N.D. NOT DETECTABLE IN PPM

Table 8-2

Raw Water Analysis

Constituent		as	Analysis in ppm	in meq/l
CATIONS:	Calcium	CaCO3	60	1.2
	Magnesium	CaCO3	60	1.2
	Sodium	CaCO3	100	2.0
	Hydrogen	CaCO3	-	-
Total cations		CaCO3	220	4.4
ANIONS:	Bicarbonate	CaCO3	88	1.8
	Carbonate	CaCO3	-	-
	Hydroxide	CaCO3	-	-
	Sulfate	CaCO3	37	0.7
	Chloride	CaCO3	93	1.9
Total anions		CaCO3	220	4.4
Total hardness		CaCO3	220	2.4
Methyl orange alkalinity		CaCO3	88	1.8
Iron, total		Fe	0.3	
Carbon dioxide, free		CO2	4 normal maximum	
Total silica		SiO2	4 - 12 normal maximum	
Turbidity		Kaolin	4 - 25	
Total dissolved solids		approx.	400	
pH			7.5	
Conductivity at 25°C		MHOS	800	

8.2 METEOROLOGICAL DATA

The project areas is characterized by hot and humid weather conditions with long summers (May - October), and comparatively short and mild winters (November - February). The summers are

characterized by high humidity and frequent cloud coverage with southwesterly monsoon winds. During the winters, the wind direction changes to northeast, while the humidity and temperatures are moderate.

8.2.1 Ambient Temperatures

The average mean, maximum and minimum monthly temperatures of the area for the period 1975 - 84 are shown in Table 8-3. It is seen from the data that the maximum temperatures during the year range between 28°C to 43°C and the minimum between 6°C to 27°C. It is also observed from the available data that the hottest period of the year is May - June and the coldest is in January.

8.2.2 Precipitation and Humidity

Humidity and the precipitation data (in mm) for the years 1975 - 84 was studied, and the monthly average figures are given in Table 8-4. The table and a reference to the other pertinent records showed that the frequency of fog is maximum at the outset of the northeast monsoons in the months of October to January, with April to September free from fog. On the average, however, there are 10 occasions of fog in a one year period. The visibility in the area is generally fair and limited to a small amount of haze.

The Table 8-4 shows that the relative humidity is maximum from May to August (75% - 85%) corresponding to the onset of the southwest monsoons and is minimum (60% - 70%) in December and January. Since the area is generally humid as a result of the influence of the Arabian Sea, the variation in the annual average

relative humidities is not large and is of the order of 30% only. The average diurnal maximum for relative humidity in July and January are recorded as 59% - 75% respectively.

8.2.3 Atmospheric Pressure

Refer to the Table 8-5 "Atmospheric Pressure for Karachi" attached.

8.2.4 Wind

Winds in the area are predominantly in the direction of southwest and west and strongest during the summer mansoon season of May to October. During the winter months the wind blows from north to northwest, shifting southwest to west in the evenings. The data for the past ten years, i.e. 1975 - 84, was studied, and typical wind rises for summer and winter are presented in Fig. 8-1. From these wind rises, it is obvious that the areas most frequently influenced by the pollution originating from the power plant are in the east and northeast direction from the plant. The wind usually carries sand and salt resulting in severe corrosion and erosion, affecting all buildings and equipment. It is therefore necessary to take great care of equipment and facilities design and construction.

Table 8-3 Ambient Temperature

(Average Temperatures for the period 1975 - 1984)

	Temperature ^{o}C		
Month	Max.	Min.	Mean
Jan.	28.7	6.1	18.2
Feb.	32.3	7.9	20.3
Mar.	35.4	11.5	24.1
Apr.	40.1	18.2	28.4
May	41.2	21.9	30.6
June	42.7	26.2	31.7
July	37.1	25.4	30.4
Aug.	35.5	24.2	28.7
Sept.	37.5	23.0	29.1
Oct.	38.8	15.9	27.2
Nov.	36.2	11.1	23.3
Dec.	30.8	8.3	19.6

Table 8-4 Precipitation and Humidity

(Average figures for 1975 - 1984)

Month	Average precipitation (in mm)	Average relative humidity
Jan.	12.1	62 %
Feb.	20.6	69 %
Mar.	13.1	72 %
Apr.	1.1	75 %
May	-	75 %
June	9.8	76 %
July	74.6	80 %
Aug.	100.1	85 %
Sept.	20.0	80 %
Oct.	3.1	75 %
Nov.	2.0	62 %
Dec.	8.7	65 %

Table 8-5 Atmospheric Pressures for Karachi

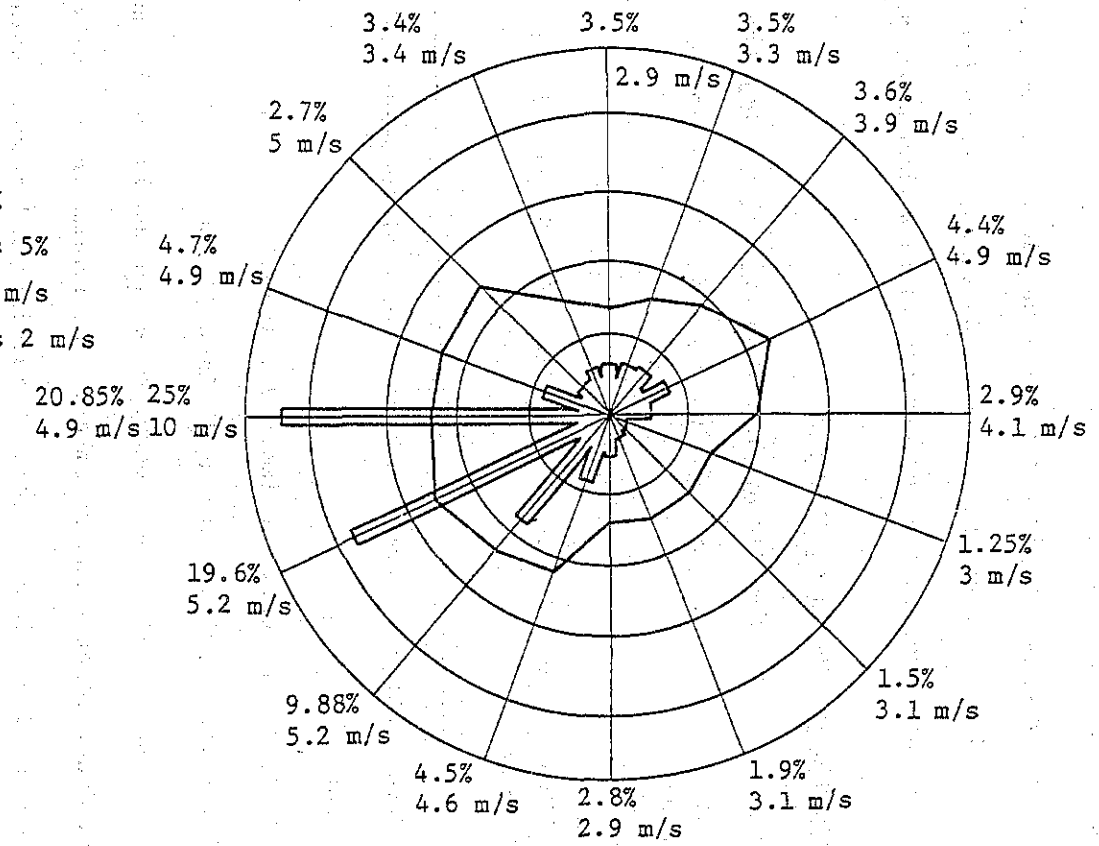
Mean pressure mb.

	G.M.T.		Mean
	0.30	12.00	
January	1017.0	1015.0	1016.0
February	1014.9	1012.9	1013.9
March	1011.9	1010.0	1010.9
April	1008.4	1006.4	1007.4
May	1004.8	1002.9	1003.9
June	999.6	997.6	998.6
July	998.4	996.7	997.5
August	1000.8	999.3	1000.0
September	1005.6	1003.8	1004.7
October	1011.0	1008.8	1009.9
November	1014.9	1012.6	1013.8
December	1017.2	1015.0	1016.1
Year	1008.7	1006.7	1007.7
No. of Years	50	50	50

Fig. 8.1 Wind Rose of Karachi-Airport

Note: Figure shows average wind velocity in m/s

1. Frequency in %
One division shows 5%
2. Wind velocity m/s
One division shows 2 m/s



8.2.5 Storms

Cyclonic storms in the Arabian Sea generally move in a west-northwesterly direction. However, sometimes (once in five to twenty five years) they take a more northerly direction, striking the coast of Pakistan.

The following table gives the total number of storms recorded in the Arabian Sea over the period of 69 years, and indicates that the average frequency of occurrence is less than 2 per year.

CYCLONIC STORMS IN ARABIAN SEA

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Total cyclonic storms	3	0	0	4	12	17	4	1	4	17	21	4
Severe cyclonic storms +)	0	0	0	4	10	12	0	0	0	6	14	1

+) Severe storms assumed to have a force of 10 Beaufort and above.

Total cyclonic storms in last 69 years: 87

Total severe cyclonic storms in last 69 years: 47

On a monthly basis storms occur more frequently in the months of May, June, October and November. The storms are normally accompanied by winds of force 8 Beaufort and above. However, winds of more than 8 on the Beaufort scale are seldom experienced at Karachi, which shows that the Karachi area does not fall within the belt of major cyclonic activity.

Thunder torms are recorded with maximum frequency in July. The percentage frequency distribution recorded at Karachi Airport

over a period of 29 years (1929-58) is given in the following table:

PERCENTAGE FREQUENCY OF THUNDERSTORMS

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1929-38	0	7	3	10	0	17	37	10	15	0	3	0
1939-48	0	11	8	0	2	4	34	26	2	0	3	6
1949-58	1	6	7	4	0	5	33	18	15	1	0	3

Source: KDA MP-PR/66 for Karachi Airport

8.3 SOIL CONDITIONS

The boring and soil tests have been executed by the Owner, and the boring logs and N-values are as summarized in the following tables and drawings.

The first part of the logs (PART-I) is a record corresponding to the soil investigation along the cooling water way outside the power station site, mainly in the Karachi Shipyard area. (As for Nos. 2 and 3 points, no records are available).

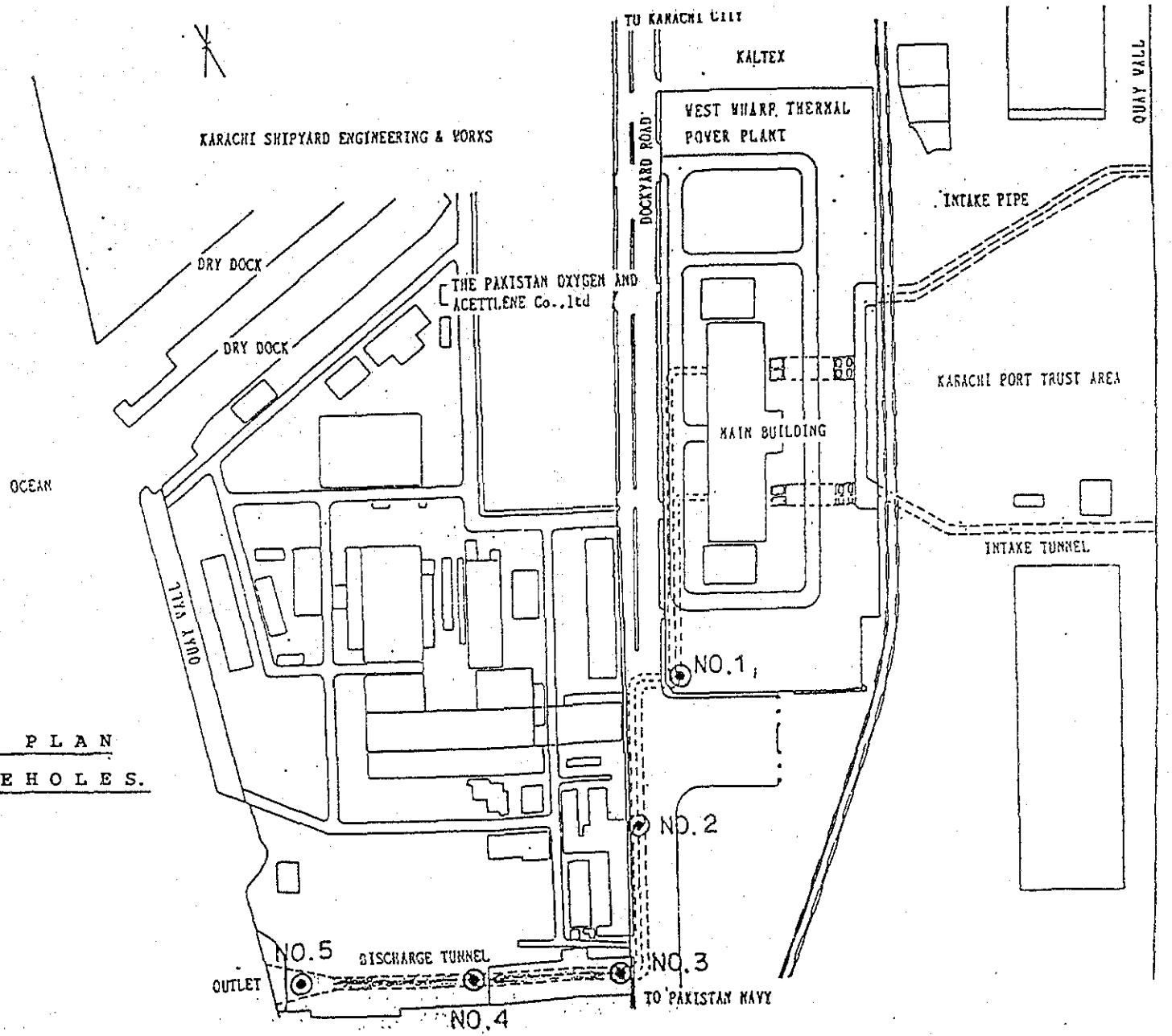
The second part (PART-II) is a record corresponding to those taken inside the power station site.

BORE LOGS

(Outside of power station)

3-52

BOREHOLES LOCATION PLAN



LAYOUT PLAN
OF BOREHOLES.

KESC WEST WHARF COOLING WATER WAY.

B O R E L O G S

KESC WEST WHARF POWER PLANT
Cooling Water Way.

BORE LOG

BORE HOLE NO: 1

Date: 26.5.89

Ground Elev: --

Ground Water Table: 4.53m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–4	4.50	4.50	Greyish brown and brownish, medium dense, fine micaceous SAND with silt and shell fragments.			25, 22, 23, 16, 6
5–10	10.50	6.00	Grey, loose to fine dense, fine micaceous SAND.			17, 52, 36, 44, 55
11–14	14.50	4.00	Grey to brownish grey, medium dense, fine to medium SAND with traces of silt, gravel and shell fragments.			19, 15
15–23	23.00	8.50	Grey, dense to very dense, Silty fine micaceous SAND.			61, 59, 58, 34
24–30	30.50	7.50	Grey, hard Silty CLAY.			32, 36, 36, 40
31			Borehole completed.			

SPT Sample: ☐

PGEL
PENCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines.
P.O. Box No: 3969, KARACHI-4

3-58

KESC WEST WHARF POWER PLANT
Cooling Water Way.

BORE HOLE NO: 4

BORE LOG

Date: 20.5.89 to 21.5.1989.

Ground Elev:

Ground Water Table: 3.38m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–31	12.50	12.50	Grey to brownish grey, loose to medium, dense silty micaceous fine SAND, with traces of shell fragments.			15, 24, 5, 23, 13, 4, 5, 17, 23, 19, 28, 38, 59, 59
	24.50	12.00	Grey dense to very dense, silty micaceous fine SAND, with occasional traces of fine gravel.			12, 15, 17
	30.50	6.00	Greyish brown, hard, silty CLAY.			23, 23, 28
			Borehole completed.			

SPT Sample: □

PGEL
PEMCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

3-57

KESC WEST WHARF POWER PLANT
COOLING WATER WAY.

BORE HOLE NO: 5

BORE LOG

Date: 16.5.89 to 17.5.1989. Ground Elev: -

Ground Water Table: 3.48m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–9	9.45	9.45	Grey to dark grey loose to medium dense fine to medium SAND with shell fragments.			18, 5, 11, 11, 5, 6, 10, 10, 4
10	10.45	1.00	Greyish brown, stiff silty CLAY.			13
11–19			Greyish brown dense fine to medium micaceous SAND.			42, 39, 39, 40, 44
20	20.45	10.00				
21–22	22.00	1.55	Brown very dense fine to medium SAND with gravel.			100
23	23.00	1.00	Brown very dense fine SAND			42
24–29			Greyish brown hard Silty CLAY.			132, 12(, 13(
30	30.50	7.50				
31			Borehole Completed.			

SPT Sample: □

PGEL
PEMCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

3-58

LABORATORY RESULTS

09-E

B.E. (Civil), M. Engg. (Soil)

CLIENT : PEMCON GEO-ENGINEERING LIMITED

PROJECT : COOLING WATER WAY THERMAL POWER PLANT

LOCATION : WEST WHARF

ground engineering services
35, Maniya Colony, off Shaheed-e-Millat Road, Karachi-5 Tel: 425728-422111

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT)

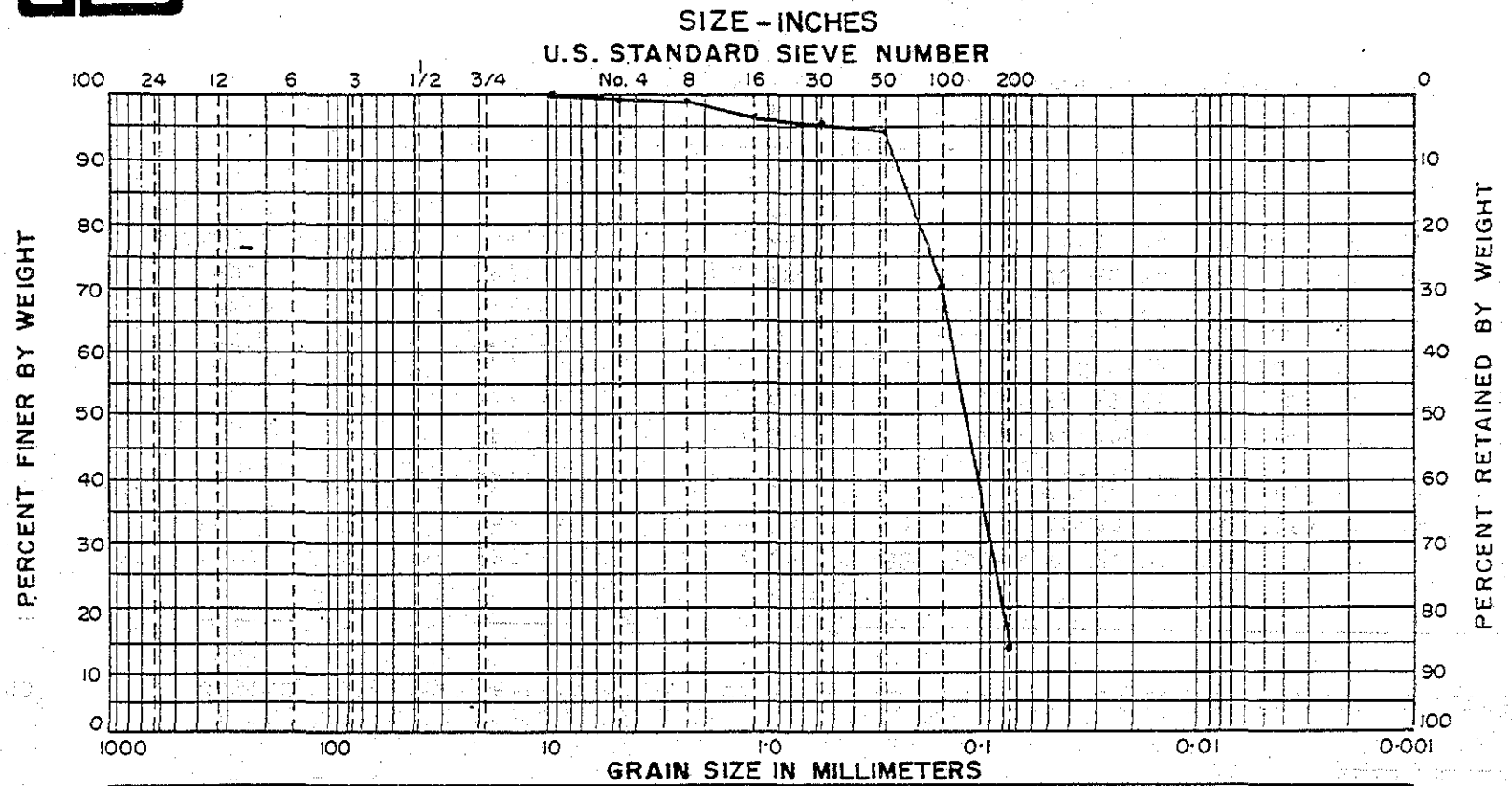
S.NO	BORING NO.	SAMPLE	DEPTH (m)	SIEVE ANALYSIS 3/8"	NO.4	8	16	30	50	100	200	HYDROMETER (DIA IN mm) .05	.01	.005	.001
1.	BH-1	SPT-4	4.00	100	99	99	97	96	94	71	14	-	-	-	-
2.	BH-1	SPT-11	12.00	100	88	70	52	43	35	18	05	-	-	-	-
3.	BH-1	SPT-15	20.00					100	99	77	18	10	01	-	-
4.	BH-4	SPT-4	4.00			100	99	98	97	74	12	-	-	-	-
5.	BH-4	SPT-11	12.00			100	99	99	99	74	20	11	01	-	-
6.	BH-4	SPT-15	20.00						100	95	34	18	05	01	-
7.	BH-5	SPT-4	4.00		100	98	90	85	80	57	11	-	-	-	-
8.	BH-5	SPT-11	12.00				100	99	98	70	22	12	01	-	-
9.	BH-5	SPT-15	20.00					100	99	76	20	09	01	-	-

.....

for GROUND ENGINEERING SERVICES

RAFIQ ESSA

GES



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-1	SPT-4	4.00m				

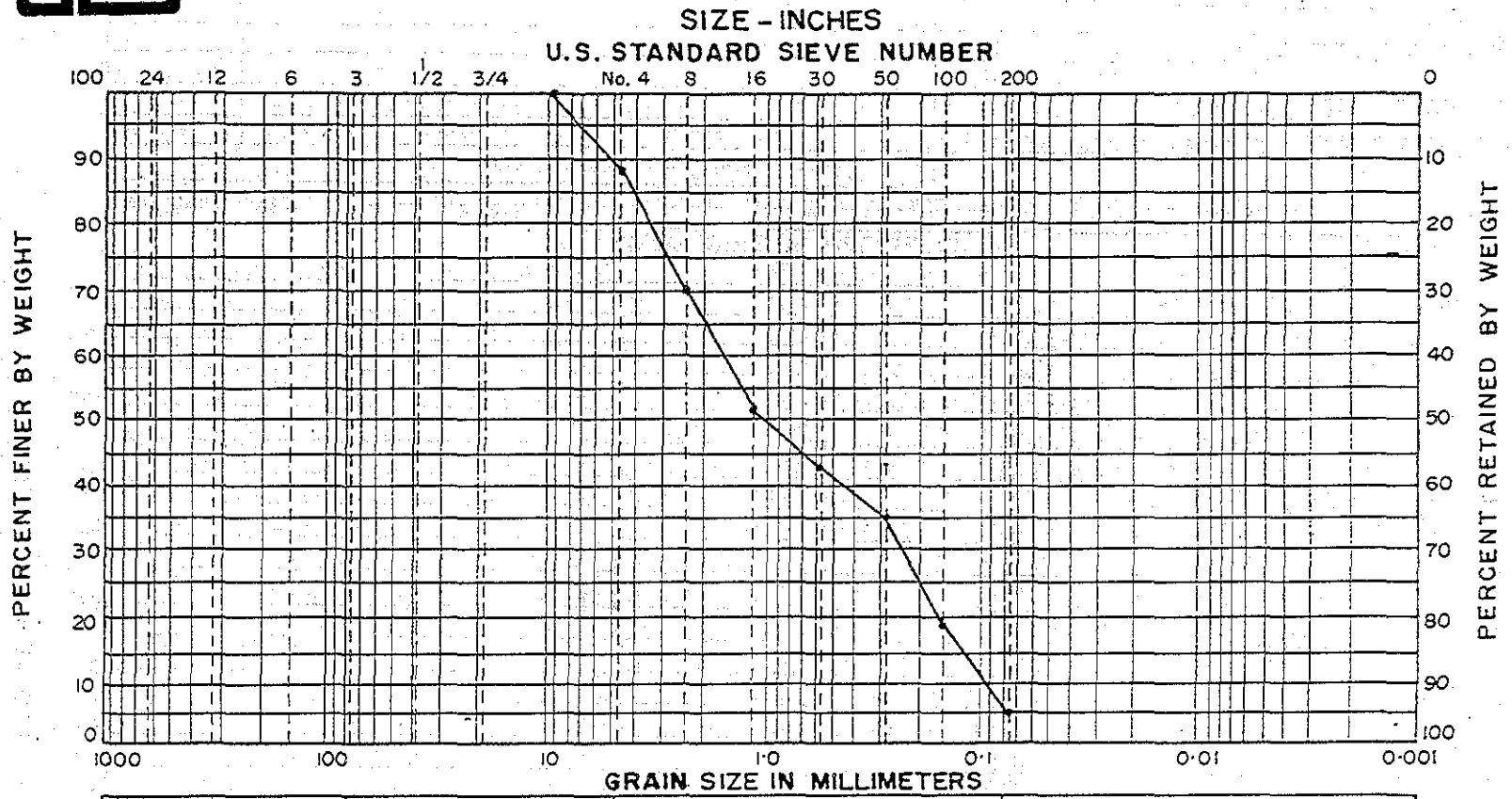
PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

3-61

29-E

GS



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

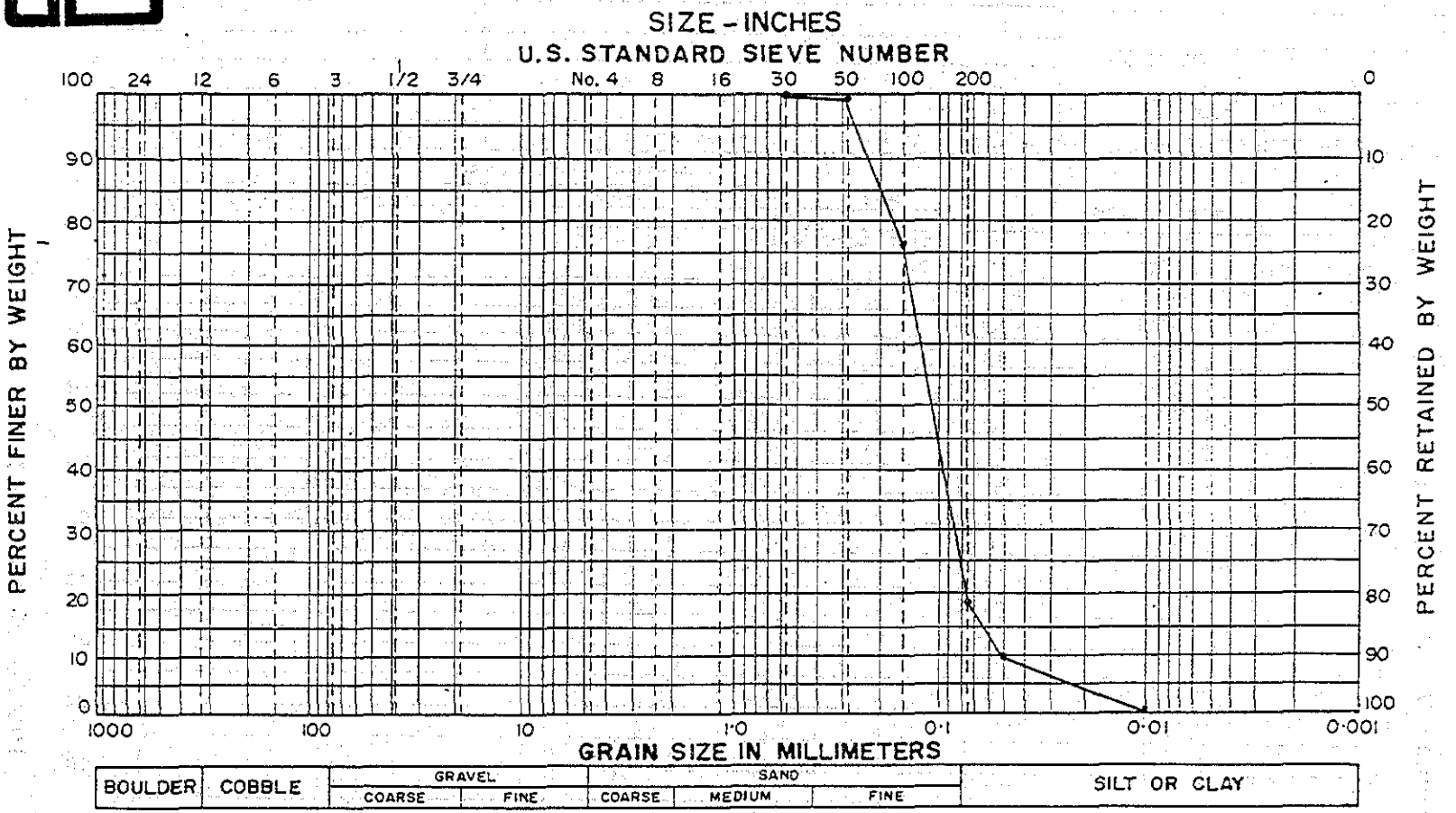
GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-1	SPT-11	12.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

GS



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-1	SPT-15	20.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

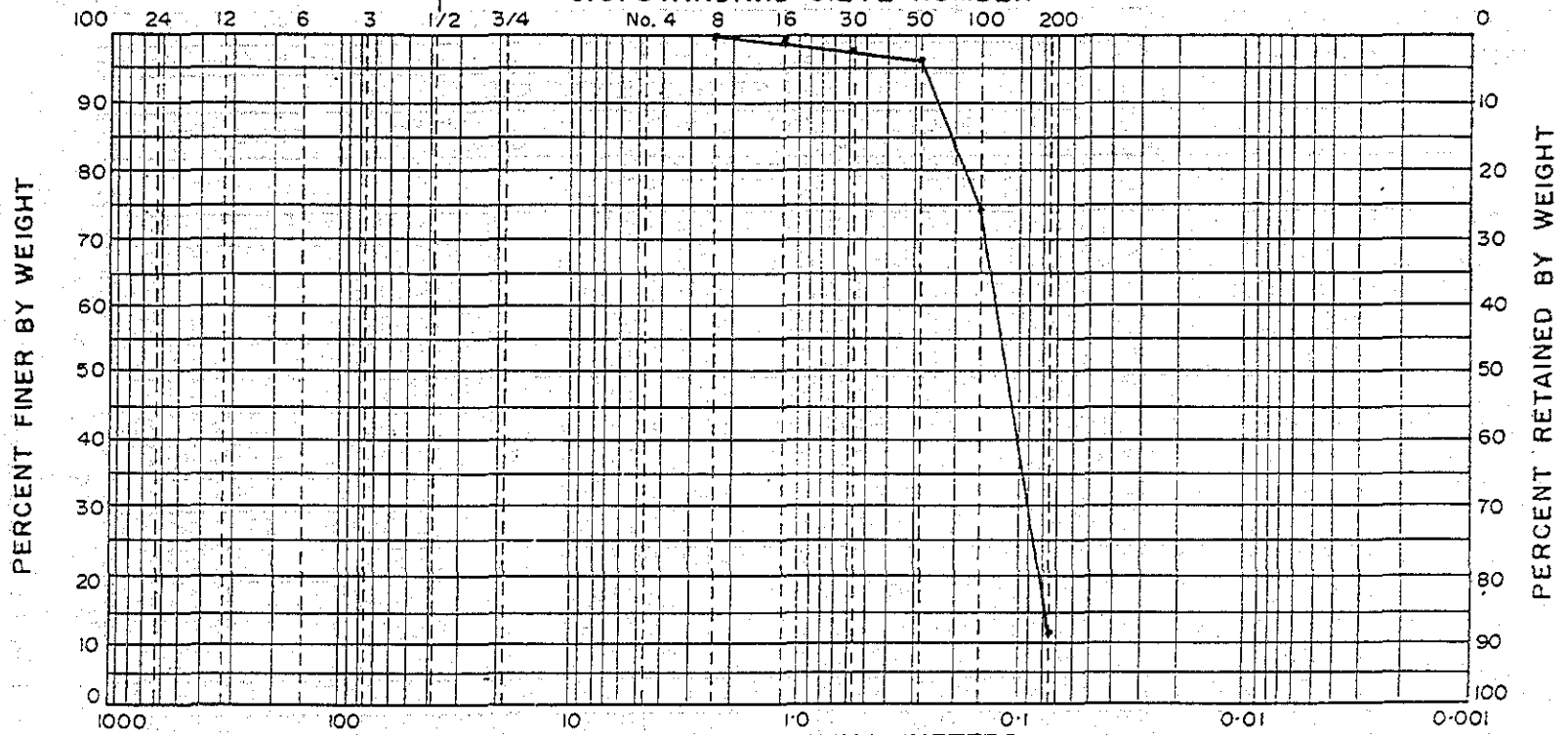
LOCATION WEST WHARF

3-63

GES

SIZE - INCHES

U.S. STANDARD SIEVE NUMBER



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

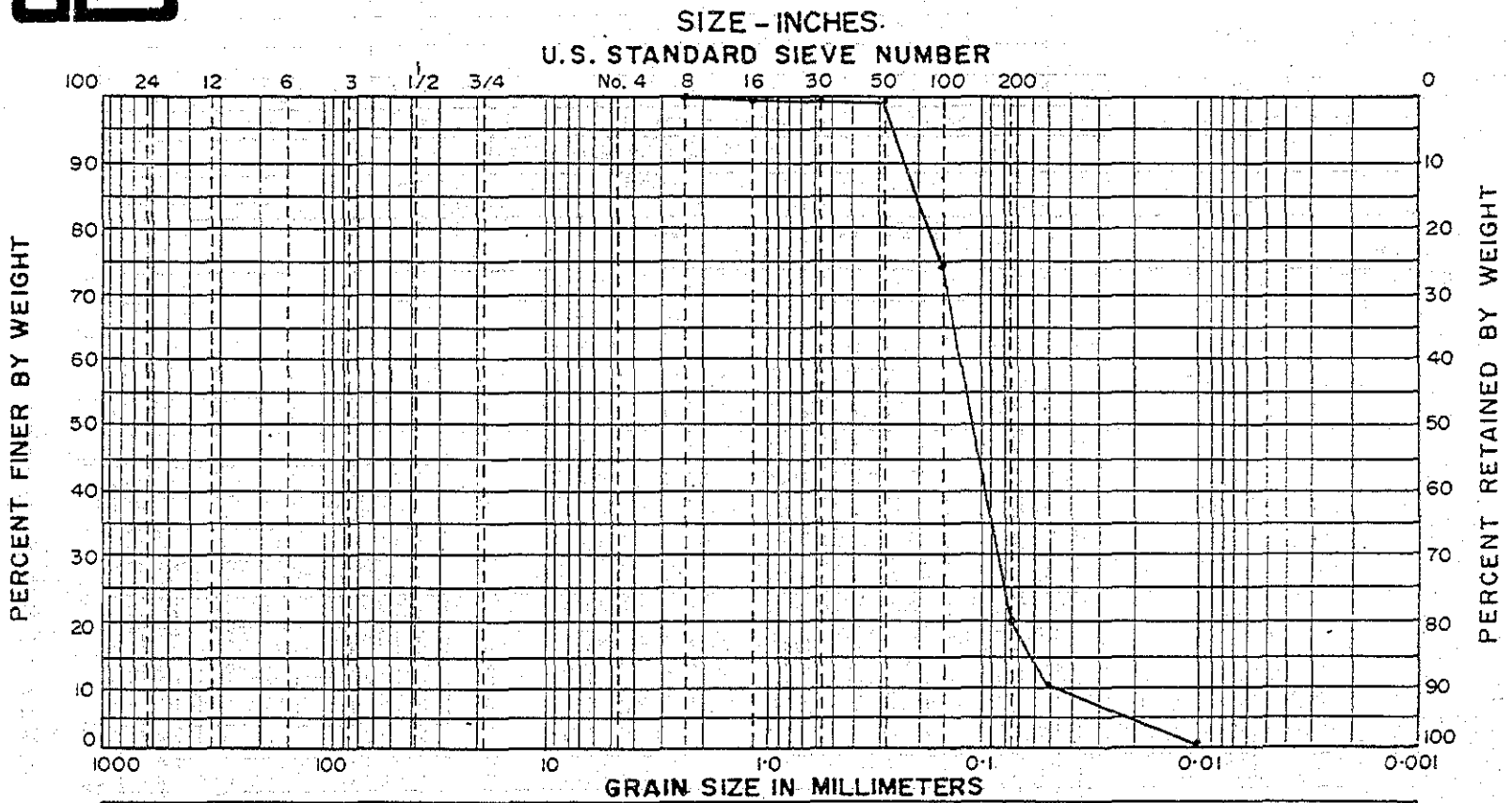
GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-4	SPT-4	2.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

GS



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-4	SPT-11	12.00m				

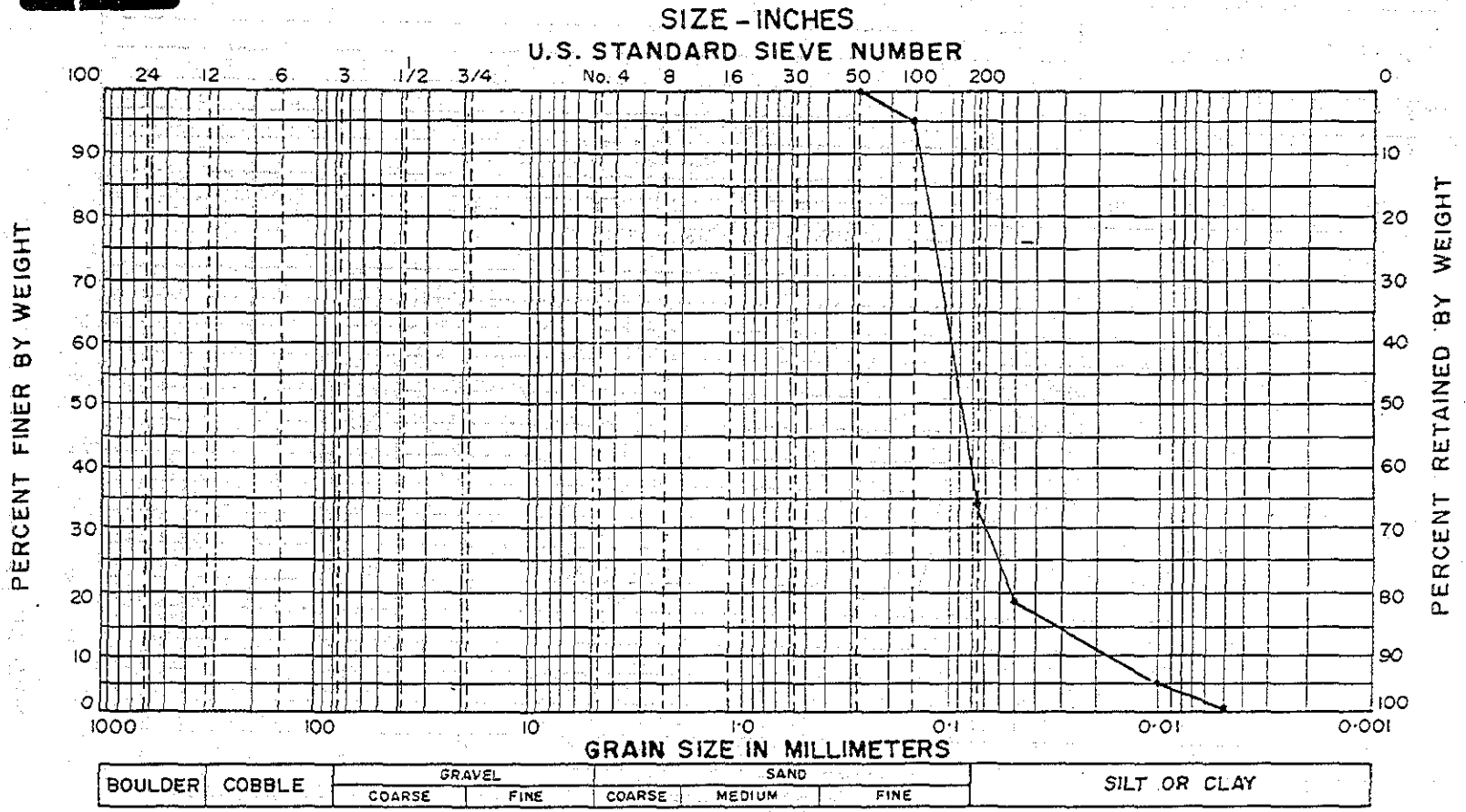
PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

3-65

99-E

GS



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-4	SPT-15	20.00m				

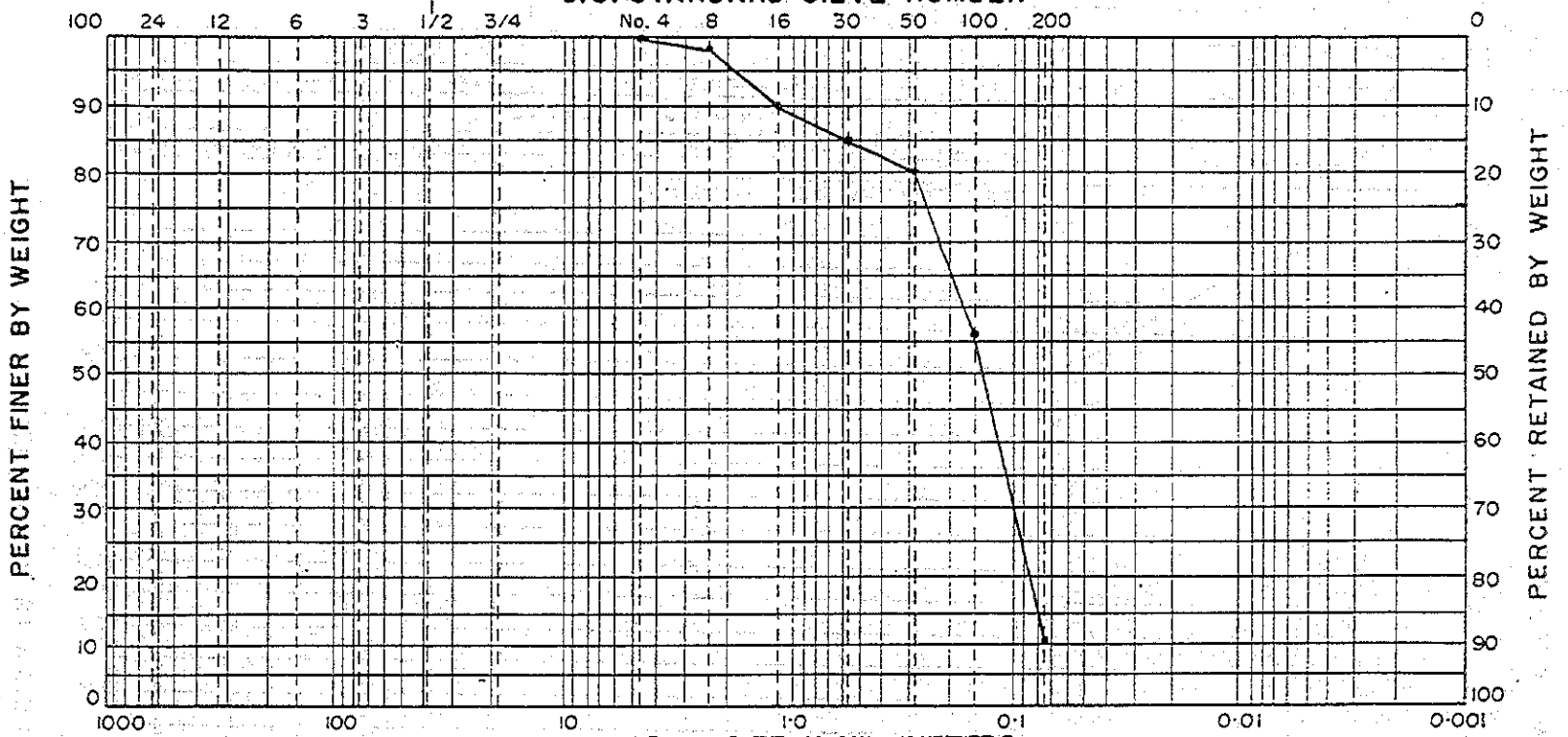
PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

GS

SIZE - INCHES

U.S. STANDARD SIEVE NUMBER



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT. NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-5	SPT-4	4.00m				

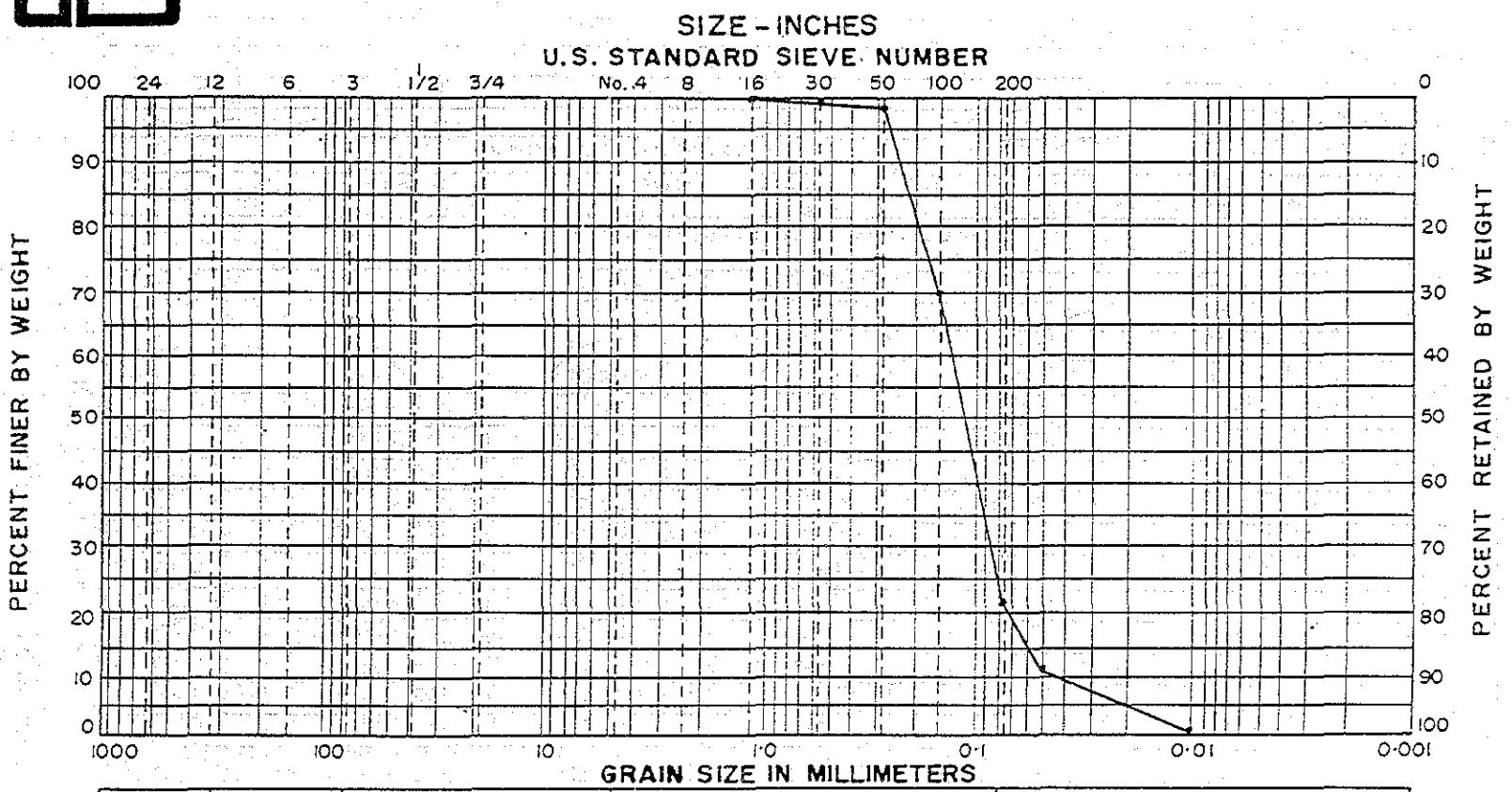
PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

3-67

89-E

GES



BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-5	SPT-11	12.00m				

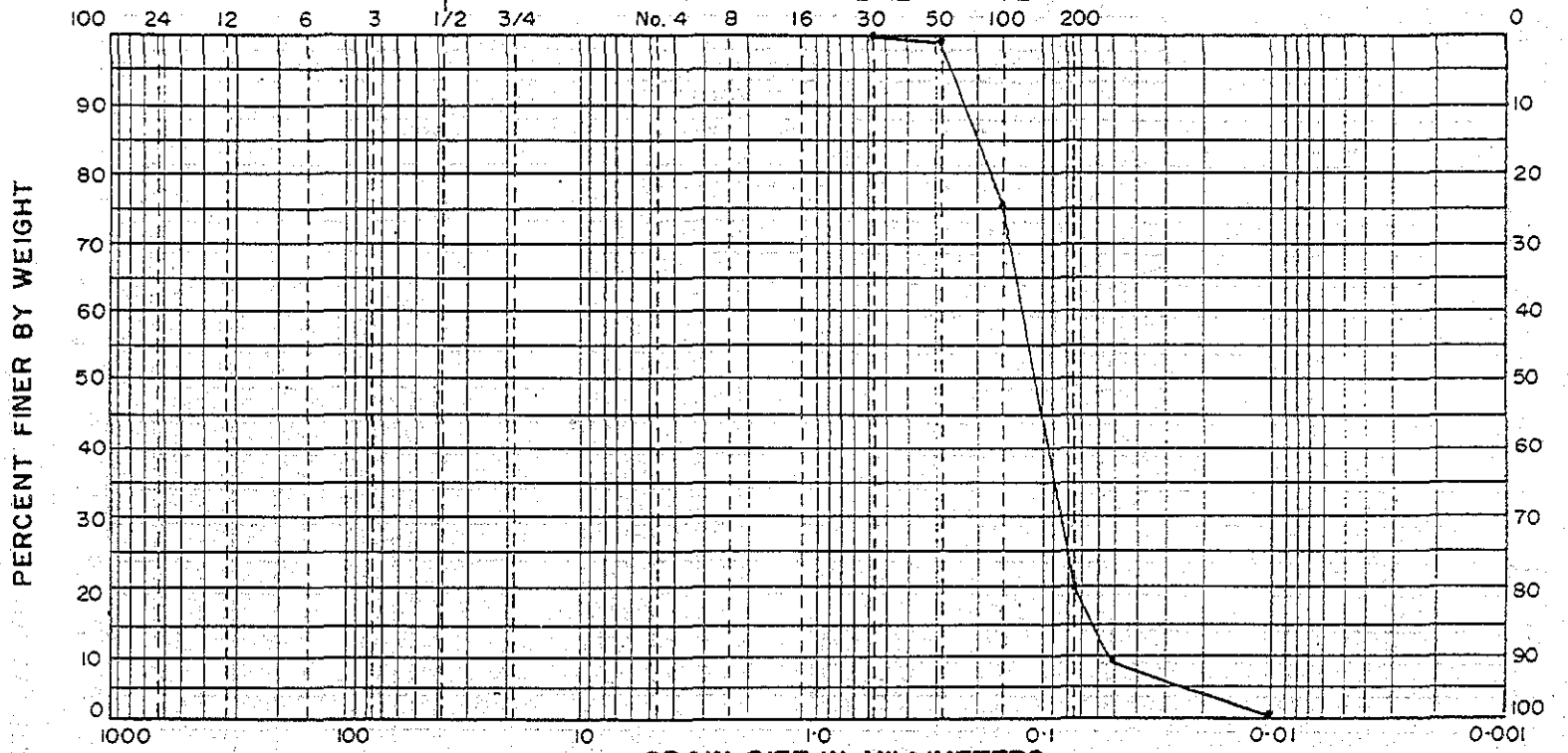
PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

GES

SIZE - INCHES

U.S. STANDARD SIEVE NUMBER



GRAIN SIZE IN MILLIMETERS

BOULDER	COBBLE	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVES

BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-5	SPT-15	20.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

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BORE LOGS

(Inside power station)

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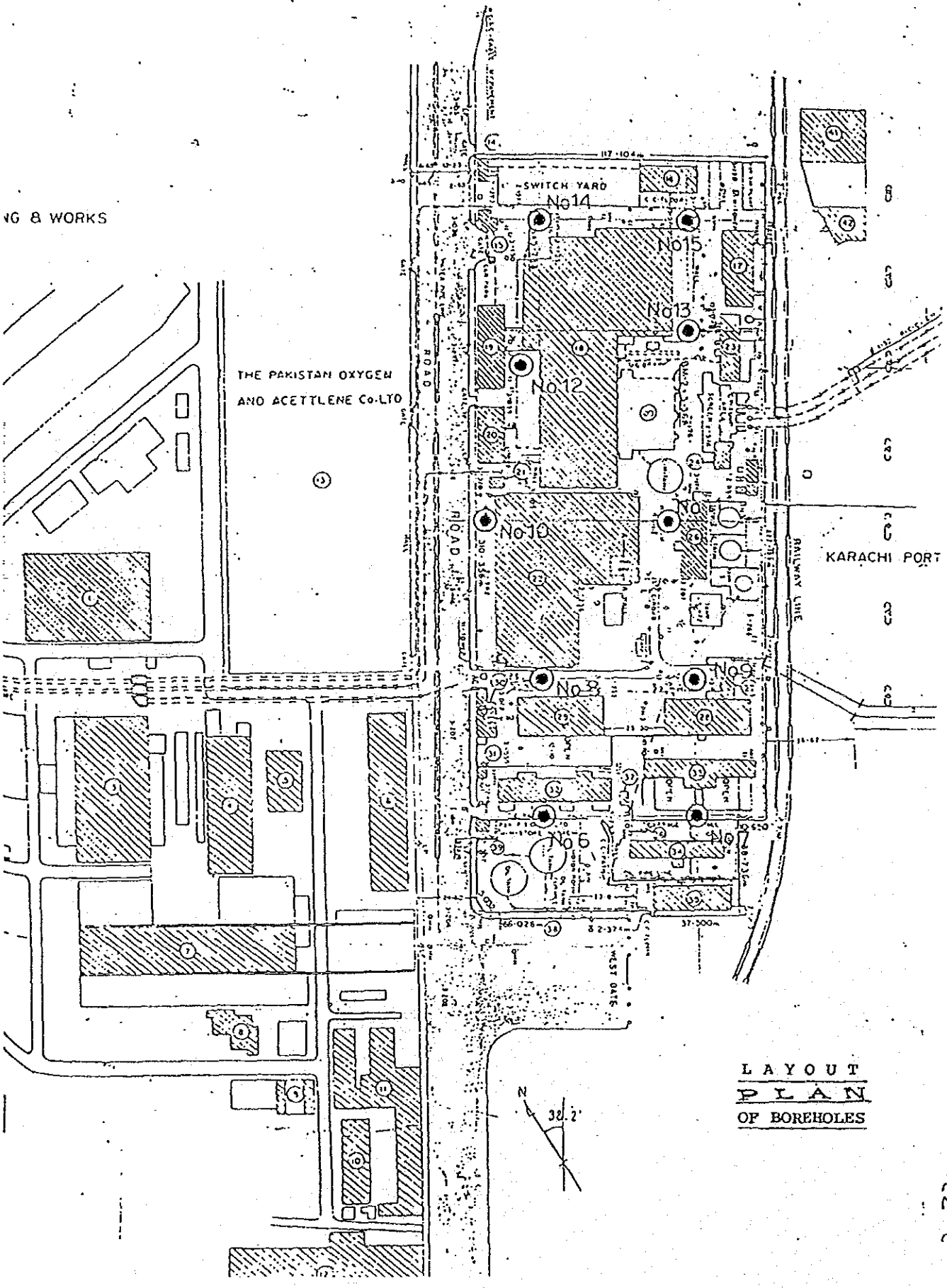
BOREHOLES LOCATION PLAN

WEST WHARF STEAM POWER PLANT PROJECT



LAYOUT
PLAN
OF BOREHOLES

B O R E L O G S

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 6

BORE LOG

Date: 15.5.89 to 16.5.1989 Ground Elev: 4.633m Ground Water Table: 4.16m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–2	2.00	2.00	Brownish medium dense fine to med. SAND with gravel.			16, 10
2–3	2.50	0.50	Brownish medium dense fine SAND with shell fragments.			12
3–6	3.50	1.00	Brownish medium dense medium to coarse SAND with shells.			7, 10
7–9	9.50	6.00	Greyish medium dense fine SAND with mica and shell fragments.			16, 16, 29
10–11	11.00	1.50	Brownish grey stiff Silty CLAY.			15, 13
12–18	18.50	7.50	Greyish dense fine SAND with mica.			30, 34, 46, 46
19–26	26.50	8.00	Greyish very stiff to hard Silty CLAY.			72, 23, 68, 105
27–30	30.50	4.00	Brownish grey hard Silty CLAY with traces of sand and gravel.			17, 15
31–			Borehole completed.			

SPT Sample: ☐

PGEL
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9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

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KESC WEST WHARF POWER PLANT

BORE HOLE NO: 7

BORE LOG

Date: 14.05.1989

Ground Elev: 4.603m

Ground Water Table: 4.11m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
	2.50	2.50	Brownish grey medium dense fine SAND with mica & shell fragments.
	8.50	6.00	Grey to brownish grey very loose to dense micaceous SAND with shell fragments.
	10.50	2.00	Dark grey med. dense med. to coarse SAND with shell fragments.
	20.5	10.50	Grey very loose to very dense fine SAND with traces of mica and shell fragments.
	30.50	10.00	Greyish very stiff to hard Silty CLAY.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

18, 19, 9, 2, 12, 16, 19, 31, 11, 15, 2, 9, 52, 56, 49, 29, 28, 45, 31, 27

SPT Sample: ☐

PGEL

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3-75

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 8

BORE LOG

Date: 28.4.89 to 29.4.89. Ground Elev: 4.615m Ground Water Table: 4.11m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–2	1.50	1.50	Brownish grey medium dense fine to medium SAND.			13, 5
3–7	8.50	7.00	Grey loose to medium dense fine SAND with shell fragments and mica.			14, 9, 17, 14, 19, 19, 9
8–12	12.50	4.00	Grey loose to medium dense fine to medium SAND with some gravel.			15, 5
13–20	20.50	8.00	Brownish grey medium dense to dense fine micaceous SAND.			30, 37, 21, 16
21–22	22.50	2.00	Brownish very dense medium SAND.			83
23–29	29.00	6.50	Brownish grey hard Silty CLAY.			38, 34, 39
30–31	30.50	1.50	Brownish grey hard Silty CLAY with gravel.			87
			Borehole completed.			

SPT Sample: □

PGEL
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P.O. Box No: 3969, KARACHI-4

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KESC WEST WHARF POWER PLANT

BORE HOLE NO: 9

BORE LOG

Date: 26.4.89 to 27.4.89 Ground Elev: 4.697m Ground Water Table: 4.38m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–3	3.50	3.50	Brownish medium dense fine to med. SAND with traces of gravel.			19, 29, 17
4–5	5.50	2.00	Dark grey very loose to loose fine to medium micaceous SAND.			3, 6
6–8	9.00	4.50	Greyish medium dense medium to fine SAND with traces of mica.			19, 25, 30
9–10	10.50	1.50	Greyish medium dense fine to medium SAND with traces of mica, gravel and shell fragments.			12, 22
11–20	20.50	10.50	Grey medium dense to dense fine to medium micaceous SAND.			25, 36, 39, 17
21–27	28.00	7.50	Brownish grey hard Silty CLAY.			12, 37, 47, 84
28–30	30.50	2.50	Light brownish very dense silty fine SAND with traces of gravel and clay.			75, 56
31–			Borehole completed.			

SPT Sample: ☐

PGEL
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KESC WEST WHARF POWER PLANT

BORE HOLE NO: 10

BORE LOG

Date: 30.4.89 to 01.5.89 Ground Elev: 4.789m Ground Water Table: 4.13m

DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
3.60	3.60	Brownish grey loose to medium dense fine SAND with shell fragments.
5.00	1.40	Dark grey loose fine SAND with traces of shell fragments.
9.00	4.00	Dark grey medium dense fine SAND with mica.
10.00	1.00	Brown medium dense fine SAND with some mica.
12.50	2.50	Greyish dense fine to medium micaceous SAND.
17.00	4.50	Grey medium dense to dense fine to medium micaceous SAND with shell fragments.
19.00	2.00	Brown dense fine to medium SAND.
20.00	1.00	Brownish dense fine SAND with traces of clay.
30.50	10.50	Brownish grey to grey hard silty CLAY.
		Borehole completed.

SCALE (m): 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

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

17 4 7 6 16 27 23 10 24 32 30 26 49 56 43 32 35 40 40 36

SPT Sample: □

PGEL

PAKCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 11

BORE LOG

Date: 23.4.89 to 24.4.89 | Ground Elev: 4.810m | Ground Water Table: 3.88m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1–8	8.00	8.00	Brownish grey to grey, loose to dense, Silty fine to medium SAND, occasional traces of coarse sand and shell fragments.
8–18	18.45	10.45	Grey to brownish grey, medium dense to dense, Silty fine to medium SAND, with mica and occasional shell fragments.
18–30	30.50	12.05	Brownish, hard Silty CLAY with coarse sand and traces of fine gravel.
30–31			Borehole completed.

LOG | SAMPLE SPT/UDS. | STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100

8, 9, 12, 11, 14, 32, 37, 32, 20, 39, 28, 49, 37, 74, 85, 10[illegible], 100, 10[illegible], 100, 79

SPT Sample: □

PGEL
PEMCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

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KESC WEST WHARF POWER PLANT

BORE HOLE NO: 12

BORE LOG

Date: 11.5.89 to 12.5.89 | Ground Elev: 4.667m | Ground Water Table: 4.08m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–3	3.45	3.45	Grey to brownish grey, loose to medium dense, Silty fine SAND.			9, 17, 15
4–5	5.50	2.05	Greyish, very stiff, Silty CLAY.			23, 28, 28
6–10	10.5	5.00	Grey to brownish grey, fine to medium micaceous SAND, with traces of silt, coarse sand and fine gravel.			10, 8, 2, 15
11–18	19.00	8.50	Brownish grey to grey, medium dense to dense, fine to medium micaceous SAND, with traces of silt, coarse sand and fine gravel.			38, 48, 38, 17
19–30	30.50	11.50	Grey, very stiff to hard, Silty CLAY.			12, 20, 35, 23, 12, 13
31			Borehole completed.			

SPT Sample:

PGEL
PEMCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 13

BORE LOG

Date: 2.5.89 to 3.5.89

Ground Elev: 4.707m

Ground Water Table: 4.08m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–12	12.50	12.50	Brownish grey to grey, loose to medium dense, silty fine to medium SAND with shell fragments and mica.			7, 14, 15, 11, 5, 4, 21, 19, 9, 15, 30
13–14	14.50	2.00	Brown, very dense, medium to coarse SAND with gravel.			96
15–20	20.00	5.50	Grey, medium dense to dense, silty, fine micaceous SAND.			28, 40, 40, 24, 38, 26, 34, 42
21–30	30.50	10.50	Greyish brown, very stiff to hard, Silty CLAY with occasional traces of coarse sand and gravel.			
31			Borehole completed.			

SPT Sample: □

PGEL

PENCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

18-E

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 14

BORE LOG

Date: 4.5.89 to 10.5.89 | Ground Elev.: 4.722m | Ground Water Table: 4.16m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION	LOG	SAMPLE SPT/UDS.	STANDARD PENETRATION TEST Blows/foot (N-Value) 20 40 60 80 100
1–8	8.50	8.50	Grey, loose to medium dense, fine to medium, micaceous SAND with silt and shell fragments.			4, 4, 5, 4, 8, 5, 15, 11, 4
9–10	10.50	2.00	Grey, very stiff Silty CLAY.			22
11–16	17.00	6.50	Grey and brownish, medium dense to dense, fine micaceous SAND with traces of silt.			25, 30, 35
17–19	19.00	2.00	Brownish, very dense, fine to medium SAND, with occasional gravel.			97, 110
20–24	25.00	6.00	Grey, very stiff to hard, Silty CLAY.			22, 42
25–30	30.50	4.50	Brownish, very dense, silty fine SAND.			106, 51, 53
31–			Borehole completed.			

SPT Sample: □

PGEL
PEMCON GEO-ENGINEERING (PVT.) LTD.
9 Sunny Side Road, Civil Lines,
P.O. Box No: 3969, KARACHI-4

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 15

BORE LOG

Date: 18.4.89 to 22.4.89 Ground Elev: 4.707m Ground Water Table: 4.38m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1–9	10.00	10.00	Grey to dark grey, loose to medium dense, silty fine micaceous SAND with occasional shell fragments.
10–19	20.50	10.50	Brownish grey, medium dense to very dense, fine to medium SAND with traces of silt and gravel.
20–29	30.50	10.00	Brownish grey, hard Silty CLAY with occasional gravel.
30–31			Borehole completed.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

12, 15, 15, 4, 4, 20, 16, 8, 10, 16, 20, 55, 69, 52, 50, 33, 90, 14, 16, 14

SPT Sample: □

PGEL

PEMCON GEO-ENGINEERING (PVT.) LTD.
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P.O. Box No: 3969, KARACHI-4

E8-C

9. DESIGN CONDITIONS

Description	Conditions	Remarks
(1) Ambient temperature		
Maximum	47.8°C	
Average Maximum (Summer)	42.7°C	
Average Minimum (Winter)	6.1°C	
Design Temperature	32°C	
	Max. 50°C, Min. 6°C	
(2) Relative humidity		
Mean Maximum	85%	
Design Humidity	75%	
(3) Atmospheric pressure	1.013 mb	
(4) Intensity of rainfall	____	
(5) Design wind velocity	50 m/s (111.8 MPH)	
(6) Design wind force	Fw = C.q.A.	C:Shape factor (According to Japanese Standards) q:Wind pressure 150 kg/m^2 height below 10 m) $45\sqrt{H}$ kg/m^2 (height above 10 m) A:Projected area (m^2)
(7) Seismic coefficient	0.1	

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(8) Design seismic force

The design seismic force shall be determined by the story shear coefficient calculated according to the equation:

Ci = Z Rt Ai Co

where; Ci, Z, Rt, Ai and Co represent the following values, respectively.

Ci: Story shear coefficient of earthquake on a portion of building at a certain height

Z: 1.0 (coefficient of seismic zoning)

Rt: The value calculated represents the characteristics of vibration of a building according with the method stipulated by the Ministry of Construction, and is based upon the natural period of the building and the types of ground

Ai: The value calculated according to the method stipulated by the Ministry of Construction represents the distribution of story shear coefficient of earthquake in the direction of the height of building based upon the characteristics of vibration of the said building

Co: Standard shear coefficient

The standard shear coefficient, Co, shall be 0.10.

(9) Sea water temperature

Maximum	33 ^{o}C
Design point	30 ^{o}C

(10) Sea water level

H.H.W.L (Highest High Water Level)	EL + 3.23 m
M.S.L (Mean Sea Water Level)	EL + 1.64 m

L.L.W.L (Lower at Low Water Level) EL - 0.43 m

(11) Ground level (G.L) EL + 4.8 m

(12) Building elevation

Ground Floor EL + 5.0 m (GL + 0.2 m)

(13) Fuel oil analysis

i) Furnace Oil Analysis

			% by weight	
Conradson carbon	(C)	% wt	20	Max
Hydrogen	(H2)	% wt	11.3	Max
Sulphur	(S)	% wt	3.5	Max
Oxygent + Nitrogen	(O2 + N2)	% wt	2.5	Max
Ash		% wt	0.1	Max
Sediments		% wt	0.25	Max
Kinetic visosity at 50°C		cSt	400	Max
Specific gravity at 15/4°C			0.99	Max
Water volume		% wt	1.00	Max
Flash point		°C	66	Max
Pour point		°C	35	Max
Vanadium		ppm	150	Max
Sodium		ppm	50	Max
Heating value		Kcal/kg	10,000	Min

ii) Test Report

Test Report No.: HDIP/F/85/63 Date: May 5th, 1985

Sample: Furnace Oil Date of Sample:

Sample Recd. on: April 13th 1985

Origin: Karachi Electric Supply Corporation Ltd.
Korangi Thermal Power Station

Test method	Test title	Test result
ASTM D - 445	Kinematic viscosity @ 50°C cSt	137.37
ASTM D - 92	Flash point COC °C	166
ASTM D - 95	Water by Dean & Stark Vol.%	0.2
ASTM D - 1298	Specific gravity @ 60/60°F	0.9444
ASTM D - 96	B.S. & W. Vol.%	0.4
ASTM D - 482	Total ash wt.%	0.06
ASTM D - 1548	Vanadium PPM	30
ASTM D - 240	Calorific value Gross B tu/lb	18350
	Net B tu/lb	17515
IP - 63	Sulphur content by Quartz tube method wt.%	2.32

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(14) Natural gas (auxiliary fuel) analysis

Natural Gas Typical Analysis

	% by volume	
	Use for performance calculations	Variation
Methane (CH4)	93.5	90 - 96
Ethane (C2H6)	0.9	0.5 - 1.5
Propane (C3H6)		
Butane (C4H10)	0.4	0.2 - 1.0
Complex (CnH2n+2)		
Carbon dioxide (CO2)	2.0	0.0 - 5.0
Nitrogen (N2)	3.2	3.0 - 5.0
Net calorific value kJ/m3 (STP)	34,740	33,000 - 35,000

(15) Light diesel oil (for emergency diesel engine) analysis

Light Diesel Oil Analysis

Test	Limit	Value
Color ASTM	Min.	3
Specific Gravity 16/16°C	Max.	0.92
Viscosity at 38°C cSt	Max.	13
Power Point °F	Max.	+ 30
Flash Point PMCC °C	Min.	150
Water % vol	Max.	0.25
Sediment % wt.	Max.	0.25
Strong Acid No. mg KOH/g	-	Nil.
Total Acid No. mg KOH/g	Max.	3.0
Ash %	Max.	0.02
Sulphur Content % wt.	Max.	1.0
Centane Index	Min.	40
Carbon Residue % wt. (Conradson)	Max.	1.5
Net Calorific Value kJ/kg	min.	44190

(16) Noise levels

The equipment shall be designed and constructed to reduce the operating noise levels as much as possible, and when the power station is operating at any load up to and including its maximum capacity, the following maximum noise pressure levels shall be guaranteed:

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	Noise level	Distance from Equipment
	(dB(A))	(m)
Boundary line of the Site	70	-
Indoor Equipment	80	1
Outdoor Equipment	85	1
Central control room and office room	60	-
Exceptions:		
Forced Draft Fan	$\leq$ 90	
Air Compressor	$\leq$ 85	
Boiler Feed Pump	$\leq$ 90	
Boiler Safety Valve (in activated condition)	$\leq$ 90	

(17) Quality of drinking water

Public Health Department Standards or WHO standards shall be referred to.

(18) Sand storm

The wind usually carries sand and salt.

It is therefore necessary to take great care of equipment and facilities design and construction.

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10. DESIGN, STANDARDIZATION AND INTERCHANGEABILITY

The equipment supplied shall be designed to facilitate inspection, maintenance and repair. Operational excellence and lowest maintenance requirements are of prime concern. The design shall incorporate every reasonable precaution and provision for the safety of those involved in the operation and maintenance of the power station. The equipment shall be designed to operate satisfactorily under all variations of load, pressure and temperature as may be encountered in normal usage under different climatic conditions given in the related Section of the Specifications and shall operate without undue vibration and with the least noise.

Corresponding parts throughout shall be made to gauge and be interchangeable wherever possible.

All equipment performing similar duties shall be of the same type and make in order to limit the stock of spare parts required and maintain uniformity of plant and equipment to be installed. The Owner reserves the right to advise the Contractor of preferred type and manufacture to secure these requirements of equipment.

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11. HAZARDOUS AREAS

11.1 HAZARDOUS AREAS

The Contractor shall fully take into account of any special requirements concerning the nature, handling and storage of all fuel oils, gases, chemical, etc., and provide plant, equipment, buildings and other services accordingly, including all facilities to ensure the safety of the operating and maintenance personnel.

In the West Wharf Thermal Power Station, regarding Units 1 and 2 the following areas shall be deemed as Class I Hazardous Areas in accordance with the criteria of Article 500 of the National Fire Codes.

i) Burner area

ii) Natural gas station

iii) Valve, flange joints, pressure gauges and other instruments attached directly to natural gas pipeline

11.2 ELECTRICAL EQUIPMENT IN HAZARDOUS AREA

Explosionproof equipment properly designed and manufactured shall be installed within the hazardous areas.

The Contractor shall submit his proposal regarding the planned hazardous areas together with a list of the equipment to be applied for prior approval.

11.3 FIRE PROTECTION PROVISIONS

The fire protection provisions shall ensure complete safety against any fire hazard, and shall be in accordance with accepted practices in plant operation and maintenance:

such as;

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(1) Fire Defence Lows of Japan.

(2) NFPA (National Fire Protection Association) Standards.

(3) Petroleum Regulations of Pakistan.

(4) Others, if applicable.

The relevant Specifications shall be covered by Clause 6 "Fire Protection System" in Section IV, Part II of these Specifications.

12. VIBRATIONS

All rotating machines and relevant equipment shall be designed, manufactured and tested to international standard for vibration levels and their balancing shall be acceptable to the Engineer.

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13. PLANT AND EQUIPMENT IDENTIFICATION

The Contractor shall prepare comprehensive plant identification schedules showing the name and number of each item of plant and its respective arrangement drawing number and add any additional items necessary to fully identify the plant. The identification and numbering of equipment, systems, items etc. of supply as well as of all documents and drawings shall be in accordance with "Numbering System for Equipment & Facilities and "Numbering Method of Control Valve, Safety Valve, Strainer and Steam Trap".

The Contractor shall supply all labels, nameplates, instruction and warning plates necessary for the identification and safe operation of the plant and all inscriptions shall be in the English language.

All labels, nameplates, instruction and warning plates shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives will not be permitted.

Nameplates for plant and equipment identification and record purposes shall be manufactured from stainless steel with satin finish and engraved with black lettering of a size which is legible from the working level.

Warning plates shall be manufactured from stainless steel with satin finish, engraved with red lettering and sited in a position which affords maximum personnel safety.

All equipment within panels, consoles and desks shall be individually identified by satin finish stainless steel labels or laminated plastic labels where approved.

The abbriviated piping designation, valve tag number and name plate,

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name plate for pannels are also covered in Section II Design Standards of this Specification.

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14. MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified and shown in these Specifications.

The equipment shall have a record of satisfactory operation and high reliability, and shall be supported by a reputable service organization.

The material and equipment shall be designed, manufactured and installed in a manner suitable to specific weather conditions.

Special attention shall be paid to corrosion by galvanic effects. Design, selection of materials as well as all methods of erection shall be such as to keep these effects to minimum.

So far as may be consistent with his obligations under the Contract, the Contractor shall make maximum possible use of materials supplies and equipment indigenous to or produced in Pakistan.

The Contractor shall prepare and submit the list of materials, supplies and equipment indigenous to or produced in Pakistan with his proposals.

15. CHEMICALS AND OTHER EXPENDABLES

The following chemicals and other expendables for operation and maintenance after taking over shall be furnished by the Contractor.

(a)	Nitrogen (N_2) gas	7 Nm^3x20 cylinders
(b)	Carbon dioxide (CO_2) gas	7 Nm^3x10 cylinders
(c)	Standard gas for gas analyzer	
	4.5% O_2 in N_2 gas	2 Nm^3x10 cylinders
	4.5% H_2 in N_2 gas	2 Nm^3x 2 cylinders
(d)	Hydrazine (N_2H_4)	100 kg (as 100%N_2H_4)
(e)	Phosphate ($Na_3PO_4.12H_2O$)	100 kg (as 100% Na_3PO_4)
(f)	Ammonia gas (NH_3)	50 kg x 10 cylinders
(g)	Sodium nitrate, bactericide (for bearing cooling water system)	100 kg
(h)	High molecular coagulant for water pretreatment system	100 kg
(i)	Coagulant for water pretreatment system	800 liters
(j)	Potassium hydroxide (KOH 25% weight)	60 liters
(k)	Dry chemical (for fire protection)	1,800 kg
(l)	Inhibitor for cooling water of main serface condenser	3,000 kg
(m)	Propane gas (C_3H_8)	2 cylinders

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(n)	Acetylene gas (C_2H_2)	2 cylinders
(o)	Hydrogen gas (H_2)	2 cylinders
(p)	Oxygen gas (O_2)	2 cylinders
(q)	Helium gas (He)	3 cylinders
(r)	Langhing gas (N_2O)	3 cylinders
(s)	Sulfuric acid (for silica analyzer)	10 kg
(t)	Ammonium molybdate (for silica analyzer)	10 kg
(u)	Tartaric acid (for silica analyzer)	20 kg
(v)	1 amino 2 napthol 4 sulphonic acid (for silica analyzer)	5 kg
(w)	Sodium hydrogen sulfate (for silica analyzer)	10 kg
(x)	Sodium sulfate anhydrous (for silica analyzer)	5 kg

16. TOOL AND RECOMMENDED TESTING EQUIPMENT

16.1 TOOL

Special tools and standard tool sets are specified in certain parts of the Specifications. Where not specified, the Contractor shall furnish suitably boxed and one (1) complete set of new and unused tools including special wrenches and tools, slings, etc. which are necessary or convenient in the operation, maintenance or overhauling of equipment under his supply. Complete lists of all such tools shall be submitted to the Owner and the Engineer soon after completion of manufacture of equipment and before its actual shipment. Shipping containers shall be suitable for permanent storage of tools by the Owner.

16.2 RECOMMENDED TESTING EQUIPMENT

(1) The recommended testing equipment means the testing equipment to be used for the maintenance purpose at the Plant. The Tenderer shall propose the required testing equipment not specified in Clauses 12 and 13 Section IV, Volume 2.

(2) The Tenderer shall indicate the quantity and unit price of Tenderer's recommended testing equipment in the attached form list in the Schedule of Prices. The cost of the recommended testing equipment will not be evaluated by the Owner. The Owner will decide the scope of the recommended testing equipment to be supplied under the Contract at a later date.

(3) The testing equipment shall be delivered to the Site in advance of the field testing.

Owner and the Contractor.

17.1.3 EXPENDITURE FOR THE OWNER'S PERSONNEL

The expenditure for the Owner's personnel during the above training shall be counted on the basis of the amount stated in item 11.7.8 Clause 11.7 in the "Instruction to Tenderers" in Section I, Volume 1.

17.2 FIELD TRAINING

(1) The Contractor shall train the Owner's personnel who will comprise plant engineer, shift supervisor, shift operator, laboratory technicians and maintenance supervisors, and this shall be done in coordination with the Engineer.

(2) The training will start beginning with assembly of the boiler, turbine, generator and other major plant components. Training in English shall be given by the Contractor during the period of installation and trial operation of the supplied equipment.

(3) The Contractor shall provide the Owner's personnel with detailed explanation of matters through lectures and on the job training regarding technical documents, drawings, operation manuals, performance of the equipment and other items required, while bearing in mind all matters pertinent to operation of the Plant and equipment by the Owner. The Contractor shall satisfactorily respond to any question or matter brought to him, and shall clarify all problematical points.

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(4) The supervisors of the Contractor shall cooperate in promoting training of the Owner's personnel regarding erection, installation, adjustment, operation and all other matters deemed necessary for proper operation of the Plant so as to realize transfer of technical knowledge and upgrade the technical level of the Owner's personnel.

(5) The Contractor's main operating personnel shall conduct on the job instruction sessions for the Owner's operation personnel prior to and during startup, trial operation and performance test periods, and shall instruct the Owner's personnel so that they will be able to satisfactorily operate and maintain the equipment after acceptance by the Owner.

(6) The Contractor shall furnish technical advisers to guide the Owner in all respects of Plant operation and maintenance by providing a minimum three (3) qualified persons having substantial experience in the operation and maintenance of steam generator, steam turbine, generator, and auxiliaries, control and instrumentation and general aspects of power plant operation and maintenance for the period of twelve (12) months (Guarantee Period) after taking over of the Plant.

18. DRAWINGS FOR TENDERING

The Drawings for Tendering used for the tendering of power plant equipment, superstructure for main power house, stack, etc., (Lot I), shall be used as the drawings for detailed design by the Contractor who shall be responsible for the detailed design of these structures.

The site layout plan, the main power house dimensions, and the figures such as dimensions, sizes and capacities stated in the Drawings for Tendering are the estimated ones for the equipment and facilities.

The Contractor shall make the final decision based on the actual design of equipment and facilities, but the Contractor shall submit the results of his designs to the Owner and the Engineer for approval.

However, as the site is narrow and rectangular, the main dimensions indicated in the site layout plan and the main power house dimensions, etc. shall be kept within those indicated in the drawings so as to realize the construction of a well arranged power station with operation and maintenance ease.

As the dimentions and outlines of each major equipment will affect the size of the main power house and finally the site layout each tenderer shall submit his drawings with the proposed site layout and equipment layout in a design concept that satisfies the intention of the Owner and the Engineer.

These proposal drawings will be one of important items for evaluation at the evaluation stage.

18.1 DRAWINGS FOR TENDERING FOR THE CONTRACTOR OF LOT I

The Drawings for Tendering are as follows.

18.1.1 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-

18.1.2 MECHANICAL

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

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WMT-1004	Flow Diagram	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

WMT-1303	Piping Layout	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

18.1.3 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 Type-2
1203	Standard Cable Tray-3
WET-1204	Standard Piping Scheme
WET-2001	Conceptional Flow Diagram of H2 Gas Seal Oil System
2002	Conceptional Flow Diagram of H2 Gas Generating System and Purging System

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18.1.4 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

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WAT-1213	Main Powerhouse	Structural Elevations Sht-4
1214	Ditto	Column Schedule
1215	Ditto	Wind Column & Girt Elevations Sht-1
1216	Ditto	Ditto 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
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 Plans
1310	Ditto	Crane Rail & Low Roof 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

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WAT-1316	Main Powerhouse A/C & Ventilation	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
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	Administration Building A/C and Ventilation	Equipment Schedule

WAT-1526	Administration Building A/C and Ventilation	Ducting and Piping Skeleton
1527	Ditto	Ground, First & Second Floor Plans
1528	Ditto	Third & Roof Floor Plans
1529	Ditto	Air Conditioning Machine Room Detailed Plan
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
WAT-1609	Auxiliary Buildings	Warehouse Sht-1
1610	Ditto	Warehouse Sht-2
1611	Ditto	Chlorination Equip. Area & Fuel Oil Transfer Pump Area
WAT-1612	Auxiliary Buildings & Outdoor Equip. Fnds.	Fuel Oil Pump & Heater Area, Fuel Oil Service Tank, Flue Gas Duct Foundation
WAT-1613	Auxiliary Buildings	Guard House, H2 Gas Generation Equip. Room
WAT-1614	Auxiliary Buildings & Outdoor Equip. Funds.	Structural Drawing (Common for WAT-1611 --- 1613)
WAT-1617	Outdoor Equip. Fnds.	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

WAT-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

18.1.5 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 Cannel
1103	Pump Pit-1
1104	Pump Pit-2
1105	Pump Pit-3
1106	Discharge Tunnel-1
1107	Discharge Tunnel-2
1108	Outlet
WCT-1201	Outdoor Pipe Support Foundation-1
1202	Outdoor Pipe Support Foundation-2
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

WCT-1208	Waste Water Treatment Facilities-3
1209	Cable Duct Foundation-1
1210	Cable Duct Foundation-2
1211	Cable Duct Foundation-3
1212	Other Foundations-1
1213	Other Foundations-2
1214	Road and Drainage System

18.1.6 REFERENCE DRAWING FOR DISMANTLING WORKS

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

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

i) PILING AND PILE CAPS

ii) CIRCULATING WATER PIPING PLANS AND SECTIONS

PART I

SECTION II

DESIGN STANDARDS

Remarks:

Note that the Design Standards in this Section shall be used as general requirements and supplements to these Specifications in Section I through VI of Part II, Technical Specifications.

Therefore, the Specifications in Part II of Technical Specifications shall be given priority in designing, manufacturing, installation and testing.

SECTION II. DESIGN STANDARDS

CONTENTS

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1. MECHANICAL PART

1.1 POWER PLANT PIPING

1.1.1 GENERAL

(1) The power plant piping is an essential component to operate the steam power plant.

The Contractor shall be required to supply complete pipings, and not fail to supply or duplicate the supply of miscellaneous pipings and related equipment.

Whenever the Engineer asks for revision or change of route of piping, the Contractor shall be required to include these works in the scope of supply of the contract.

Whenever the revision of design of piping becomes necessary during construction, the Contractor shall be required to make revision and solution at his own expense.

The Contractor shall be required to have on hand the necessary piping materials needed for field revision.

(2) The Contractor shall furnish the following power plant piping including hanger beams and steels, wall and floor penetrations, ladders, steps, and all other pertinent accessories, but not be limited to the followings.

- o Main steam piping, cold reheat piping, hot reheat piping and turbine bypass piping (if applicable)
- o Extraction steam piping
- o Auxiliary steam piping

  (for steam coil air preheater, residual oil heater, air ejector(in case of steam jet air ejectors are applied), deaerator, turbine gland seal, water treatment, steam converter, mixing heater, etc.)

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- Turbine gland seal steam piping
- Circulating water piping
- Condensate piping
- Demineralized water and raw water piping
- Drinking water piping
- Make up water piping
- Boiler spray water piping
- Boiler blowdown, drain and vent piping
- Turbine drain piping
- Feedwater heater drain and vent piping
- Condenser air removal piping
- Chemical feed piping
- Steam and water sampling piping
- Cooling water piping
- Fire protection piping, including dry chemical and air foam piping
- Air preheater wash water piping
- Chlorination equipment piping
- Heavy fuel oil piping
- Diesel oil piping
- Service air piping
- Instrument air piping
- Turbine lubricating oil and generator seal oil piping
- Generator H_2 gas and CO_2 gas piping
- N_2 gas injection piping
- Seal water piping for vacuum valves
- Safety valve and relief valve piping, including exhaust

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and drain pipings

- o Equipment drain and vent piping
- o Water treatment piping
- o Drainage and sewage piping including equipment, floor drain, etc.
- o Temporary piping

  Main steam, cold reheat, hot reheat, turbine bypass, air ejector and gland steam blowing out piping

  Hydrostatic test piping

  Chemical cleaning and boiling out piping

  Oil flushing piping

  Water flushing piping

  Steam flushing piping

  Waste water and drain piping

  Air leak test piping

  Water filling test piping

  Other necessary piping for temporary work and testing during construction

- o All other miscellaneous piping required to provide complete installation and trial operation

(3) All piping shall be furnished with a sufficient number of the following nozzles and taps as required.

- o Vent with valve and pipe
- o Drain with valve and pipe
- o X-ray or gamma ray hole
- o Sampling tap with valve and pipe
- o Chemical injection tap with valve and pipe
- o Safety valve

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- o Pressure, flow and control tap with valve and pipe
- o Thermometer tap with well
- o Pressure test gauge taps for blowing out, flushing and cleaning
- o Pressure gauge taps for safety valve test
- o All pertinents required for complete installation and testing

(4) The word "piping' includes valves, fittings, flexible hoses, expansion joints, hangers and supports, insulation, lagging or jackets, taps, instrumentation, thermowells, strainers, filters, flow nozzels, flow indicators, drain traps, etc.

(5) All hangers, hanger supports, anchors, pipe supports etc., shall be included in the scope of supply.

(a) Welded plate, clevis, pipe clamps, clamp bolts and nuts and other fittings which are usually used for pipe hangers and supports shall be included in the scope of supply.

(b) Top beam, top connection and bottom connection for the hanger shall be included in the scope of supply.

(c) The attachments for pipe supporting, such as ears, shoes, lugs, stools, trunnions, skirts, rings, slings, support for insulation, etc., shall be included in the scope of supply.

(d) All beams and sleepers which are added to the super structure for the purpose of piping shall be furnished by the Contractor.

(e) The detailed specification of hangers and supports

shall be in accordance with Clause 1.2 of "Hangers, Anchors and Supports" in this specification.

(6) Heat insulation and anti-sweat insulation for piping shall be included in the scope of supply.

(a) All fittings, such as pipe saddles and lugs, supporters of insulation, etc., shall be welded at shop before shipment.

(b) The detailed specification of insulation shall be in accordance with Clause 1.12 of "Insulation" in this specification.

(c) All insulation for drains, vents, blow downs, instrument pipings, etc., shall be included in the scope of supply.

(d) All studs, bolts, nuts, etc., required for insulation, shall be supplied by the Contractor.

(7) The Contractor shall supply all welding rods and backing rings, if required, for all piping which is included in the scope of supply. In addition, welding rods and backing rings, if required, at battery points shall be included in the scope of supply.

(8) The quantity, with allowance of welding rods, shall be estimated by the number of field welding connections in the piping.

(9) In the case of flange type connections to equipment, mating flange, bolts, nuts and gaskets for each connection shall be supplied with allowance by taking into account the number of field connections.

(10) The future extension connection of each system shall be furnished with valves and nozzles with blind flanges, bolts and nuts and gaskets.

(11) All nipples and plugs required for hydrostatic test, oil flushing, etc., shall be furnished.

(12) Necessary piping stress analysis, such as main steam pipe, cold reheat pipe, hot reheat pipe, turbine bypass pipe (if applicable), feedwater pipe, extraction steam pipe, fuel oil pipe, drain pipe of boiler blow down, auxiliary steam pipe, etc., shall be executed by the Contractor and submitted to the Owner and the Engineer for approval.

(13) The Contractor shall be required to submit the piping line list to the Owner and the Engineer for approval.
The form of the piping line list will be prepared by the Owner and/or Engineer, soon after the contract of the project becomes effective.