THE ISLAMIC REPUBLIC OF PAKISTAN

DETAILED DESIGN STUDY
ON
WEST WHARF
THERMAL POWER PLANT PROJECT

FINAL REPORT-II

LOT IIA (VOLUME 2)

JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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VOLUME 2 TECHNICAL SPECIFICATION

PART I

TECHNICAL GENERAL CONDITIONS

CONTENTS

PART I. TECHNICAL GENERAL CONDITIONS

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1. INTENT

(1) The Technical General Conditions state the specific requirements for design, storage, erection, safety, etc., which are not specified in Part II and III of this Volume 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 Application 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 covered under the Lot II-A Tender Documents are described in Volume 2 as follows:

(1) PART I - Technical General Conditions

(2) PART II - Substation and Related Facilities

SECTION I Substation and Grid Station Facilities

SECTION II 220 kV Under Ground Cables

Specifications for the design, manufacture, supply, fabrication, transportation, installation, testing, and commissioning of all equipment and materials for the 220/132 kV substations in the West Wharf Thermal Power Station and for the extention bays of the Baldia Grid Station with 220 kV underground cables between the West Wharf Substation and No. 1 tower, including furnishing of all necessary 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 3).

(3) PART III - 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 220/132 kV Substations and the extention bays of the Baldia Grid Station with the underground cable tunnel for the 220 kV

underground cables and other 132 kV cables, 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.

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 (LOT I)

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.

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 (LOT I)

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 (LOT I)

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 (LOT II-A)

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 IIA).

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 FOR LOT II A

The Contractor of Lot IIA shall carry out the scope of works as described in the following.

(1) 220/132 kV substations inside the power station including civil and architectural works

(2) 220 kV extension bays in the Baldia Grid Station including civil and architectural works

(3) Underground cable tunnel between West Wharf Thermal Power Station to No. 1 transmission tower

The detailed scope of works is specified in Volume 2, Part II and III.

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

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

The Contractor of Lot II A 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 II A 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 Substation, Grid Station and related facilities. Concerning the works of civil, architectural and structural design of the facilities, the Contractor of Lot II A shall provide plans and designs, and shall assume all responsibilities of the Plant including supervision of the civil, architectural and structural works. As the civil, architectural and structural works are also included in the scope of Lot II A, the Contractor of Lot II A 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 IIA Contractor are indicated as follows.

(1) Entire works for the 220/130 kV Substation building, the extension building of the Baldia Grid Station and the 220 kV underground cable tunnel.

(2) Reinforced concrete works for indoor equipment foundations.

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

(4) Entire works for foundations of switchgears, transformers, and other outdoor facilities.

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

5. ITEMS NOT INCLUDED IN THE SCOPE OF WORKS

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

(1) Two (2) sets of 200 MW oil fired steam power generating plants with related facilities including architectural and civil works (Contractor of Lot I)

(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

(4) Oil storage and supply system
Out of scope of this project

Detailed terminal points among each Lot are described below, but shall not be limited to.

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

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.

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 gearter 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 IIA and Lot IIB 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.

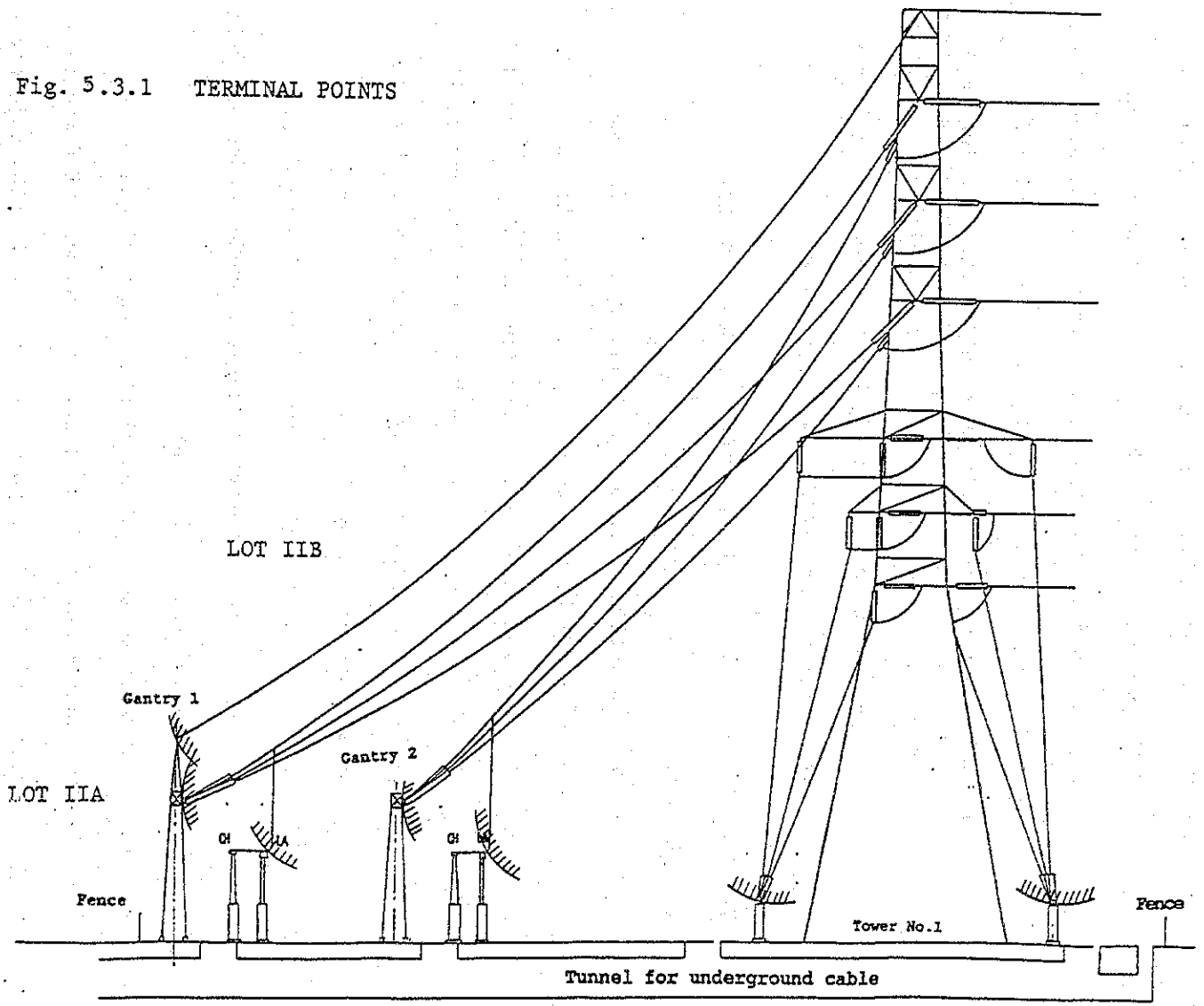
(f) The connection work of optical fiber cable with OPGW shall be carried out by the Contractor of Lot IIB.

(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.

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.

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. SITE CONDITIONS

7.1 SUMMARY

Description	Conditions
(1) Ambient temperature (Year 1975 - 1987)	
Maximum (Highest)	47.8 °C
Maximum (Monthly Mean)	42.7 °C
Maximum (Yearly Mean)	36.4 °C
Minimum (Yearly Mean)	16.6 °C
Minimum (Monthly Mean)	6.1 °C
Minimum (Lowest)	°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	mm/Month
Maximum (Monthly Mean)	100.1 mm/Month
Total Rain Fall (Yearly Mean)	22.1 mm/Month
Greatest Rainfall in a Day	152.4 mm/Day
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 + 5.160 m.

(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) Raw water analysis

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. 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.

8.1 Ambient temperatures

The average mean, maximum and minimum monthly temperatures of the area for the period 1975 - 84 are shown in Table 8-1. 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 Participation 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 8-2. 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 8-2 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.

8.3 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. 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. This area is not affected by the cyclones and thunder storms originating from the east coast of Africa or Bay or Bengal, because they normally follow a route which is several hundred kilometres south of the Karachi coast.

8.4 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

Table 8-1 Ambient Temperature

(Average Temperatures for the period 1975 - 1984)

	Temperature °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 8-2 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 8-3 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

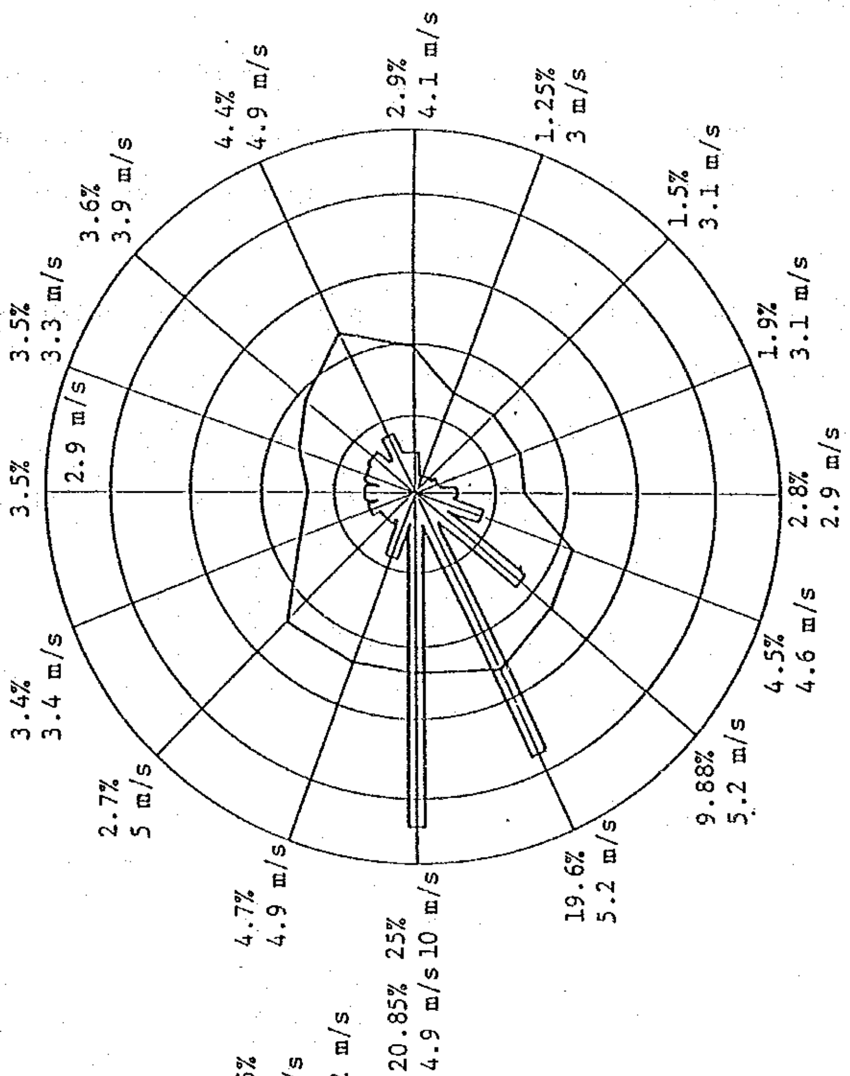


Fig. 8-1 Wind Rose of Karachi-Airport

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

9. 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 (P-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 (P-II) is a record corresponding to those taken inside the power station site.

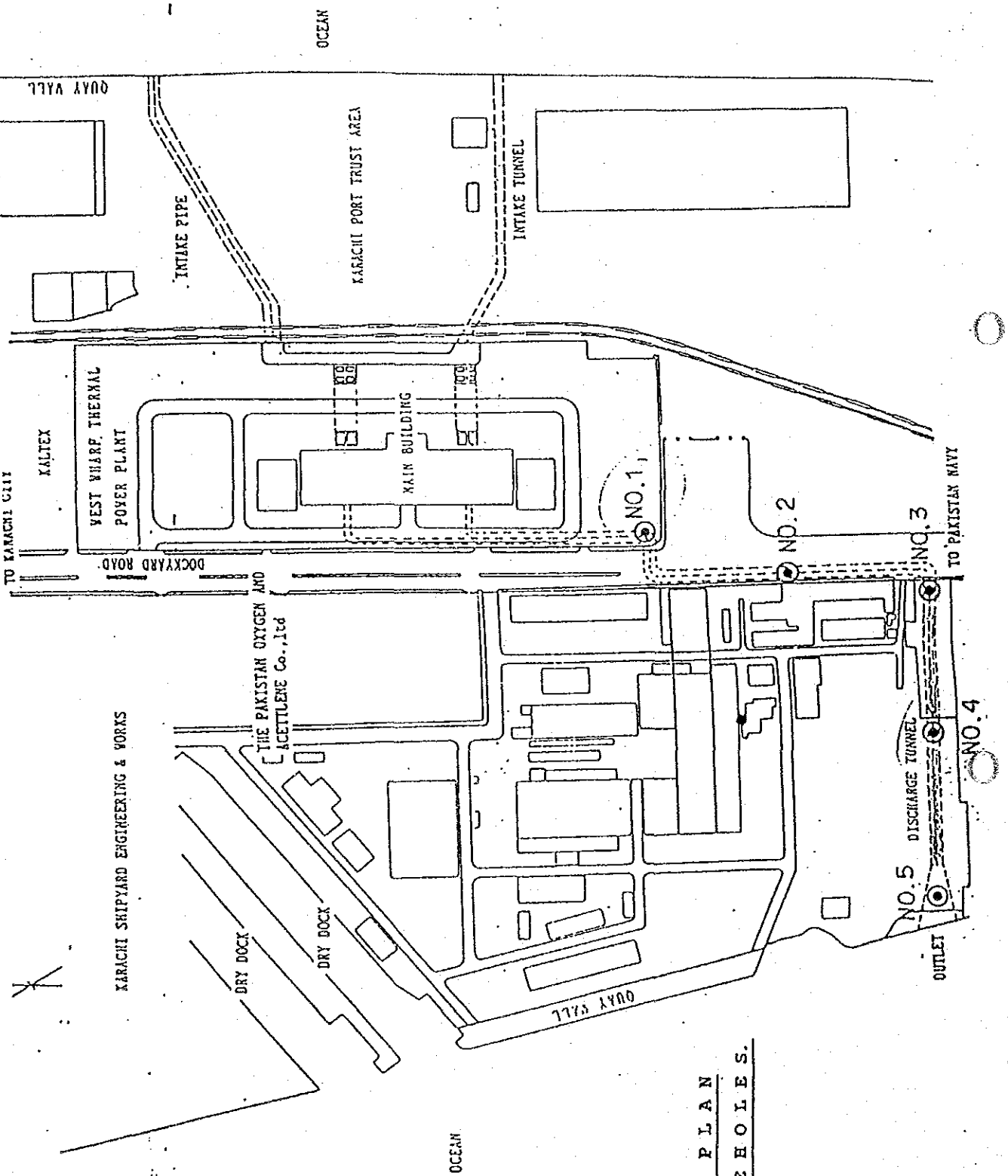
The third part (P-III) is a record corresponding to those taken along the 220 kV transmission line and Baldia Grid Station.

P-I

BORE LOGS

(Outside of power station)

KESC WEST WHARF COOLING WATER WAY



LAYOUT PLAN OF BOREHOLES.

KESC WEST WHARF POWER PLANT
Cooling Water Way.

BORE HOLE NO: 1

BORE LOG

Date: 26.5.89

Ground Elev: 4.179 m

Ground Water Table: 2.95m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1–4	4.50	4.50	Greyish brown and brownish, medium dense, fine micaceous SAND with silt and shell fragments.
5–10	10.50	6.00	Grey, loose to fine dense, fine micaceous SAND.
11–14	14.50	4.00	Grey to brownish grey, medium dense, fine to medium SAND with traces of silt, gravel and shell fragments.
15–23	23.00	8.50	Grey, dense to very dense, Silty fine micaceous SAND.
24–30	30.50	7.50	Grey, hard Silty CLAY.
31			Borehole completed.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

25 22 23 16 6 17 52 36 44 55 19 15 61 59 58 34 32 36 36 40

SPT Sample: ☐

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

KESC WEST WHARF POWER PLANT
Cooling Water Way.

BORE HOLE NO: 4

BORE LOG

Date: 20.5.89 to 21.5.1989.

Ground Elev: G.L.

Ground Water Table: 1.80m

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	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
13–24	24.50	12.00	Grey dense to very dense, silty micaceous fine SAND, with occasional traces of fine gravel.			12, 15, 1
25–30	30.50	6.00	Greyish brown, hard, silty CLAY.			23, 23, 28
31			Borehole completed.			

SPT Sample: ☐

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

1-49

KESC WEST WHARF POWER PLANT
COOLING WATER WAY.

BORE LOG

BORE HOLE NO: 5

Date: 16.5.89 to 17.5.1989. Ground Elev: X Ground Water Table: 1.90m

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
10-11	10.45	1.00	Greyish brown, stiff silty CLAY.			13
12-19	20.45	10.00	Greyish brown dense fine to medium micaceous SAND.			42, 39, 39, 40, 44
20-22	22.00	1.55	Brown very dense fine to medium SAND with gravel.			100
22-23	23.00	1.00	Brown very dense fine SAND			42
24-30	30.50	7.50	Greyish brown hard Silty CLAY.			132, 126, 130
31			Borehole Completed.			

SPT Sample: □

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

K-8

LABORATORY RESULTS

15-C

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

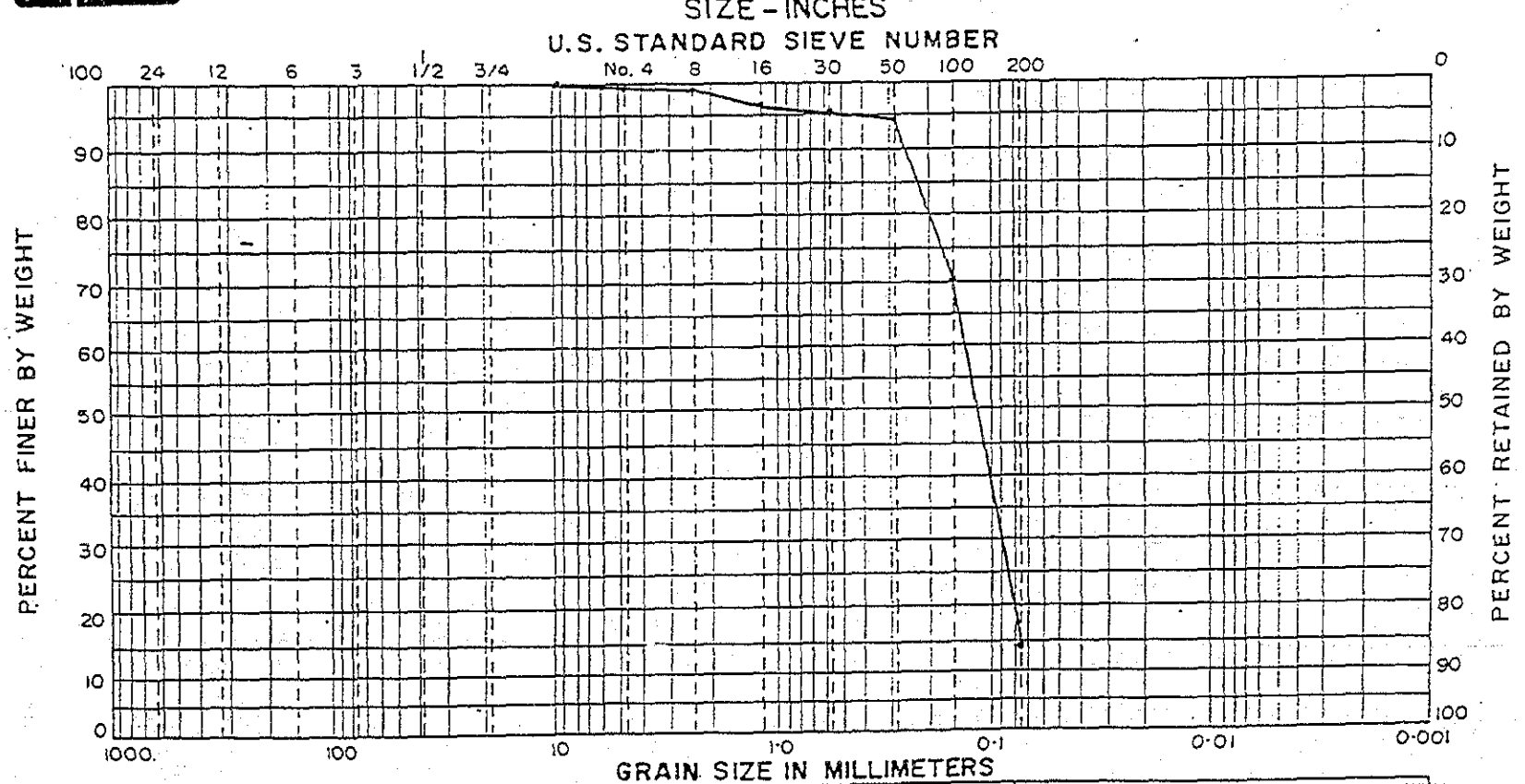
GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT)

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

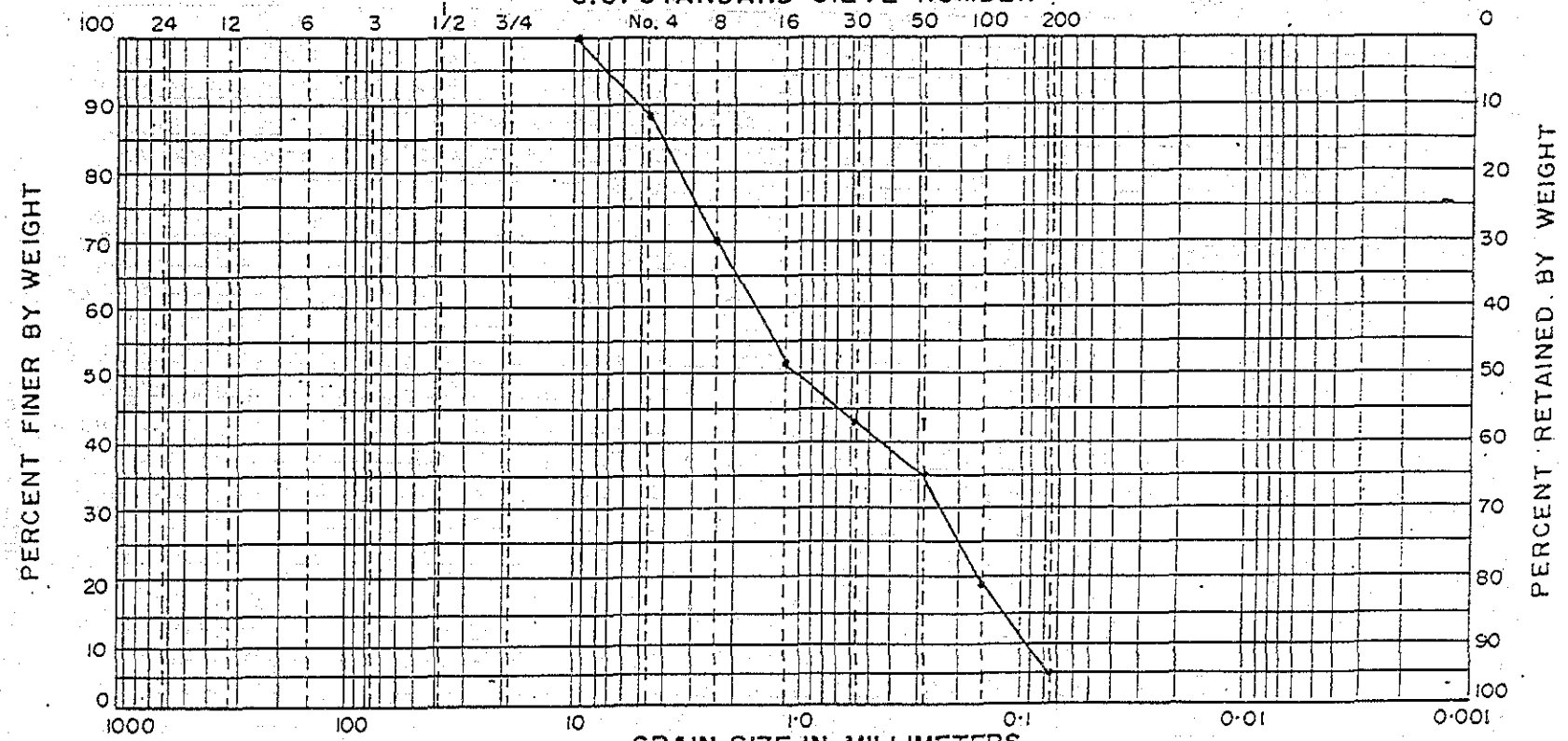
LOCATION WEST WHARF

2-52

GES

SIZE - INCHES

U.S. STANDARD SIEVE NUMBER



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

GRADATION CURVES

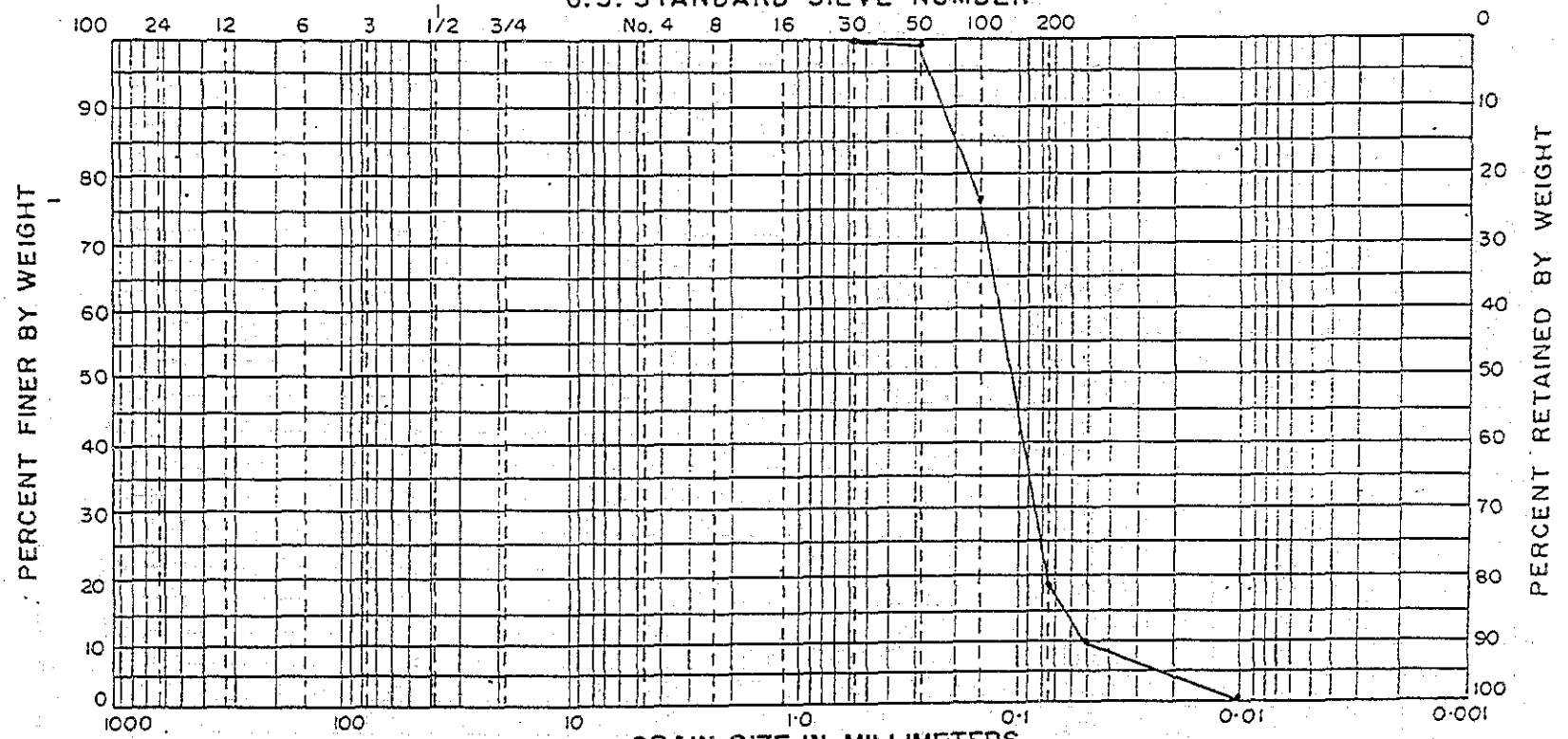
BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-1	SPT-11	12.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

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

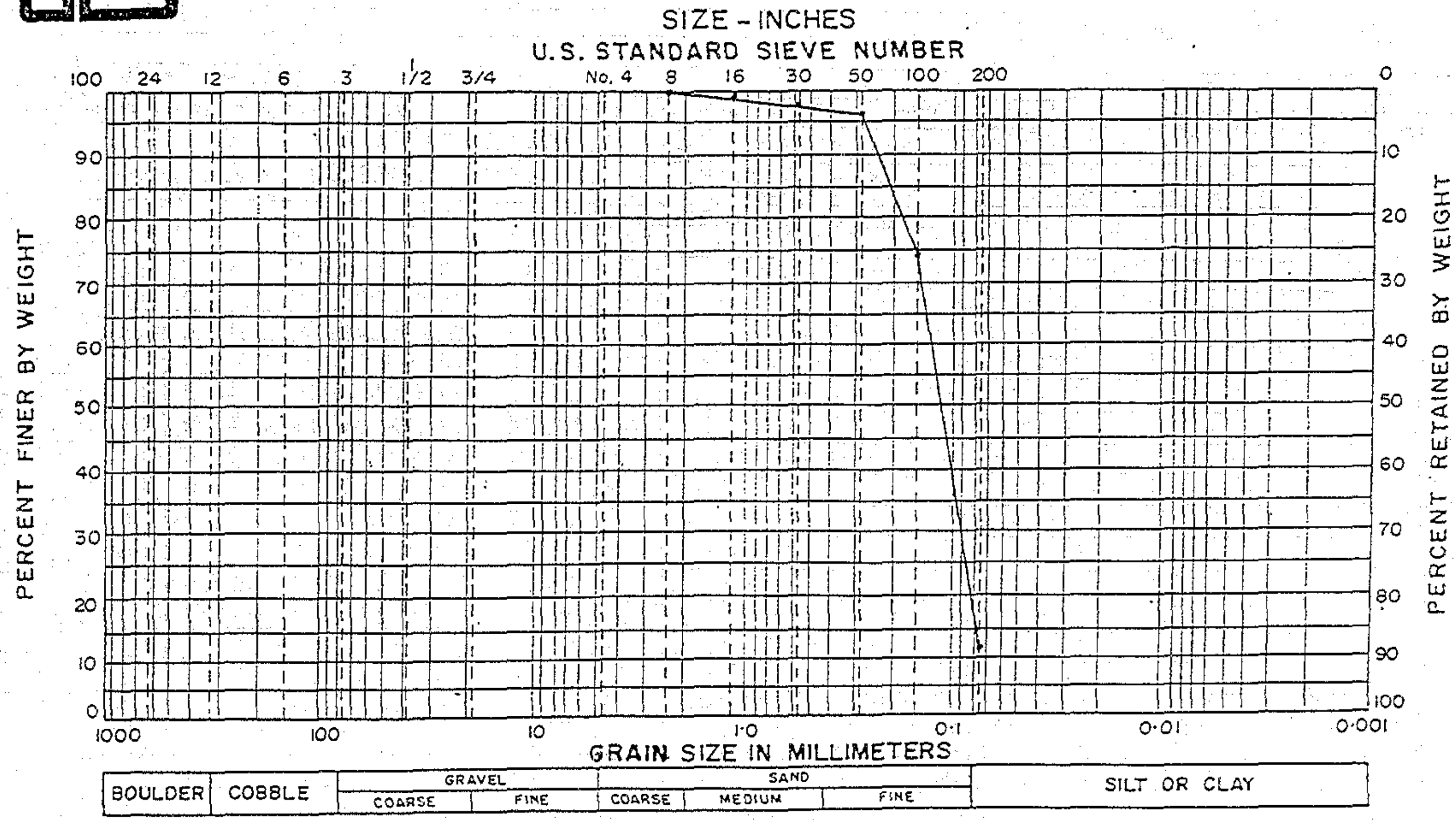
BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-1	SPT-15	20.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

2-5K

55-7

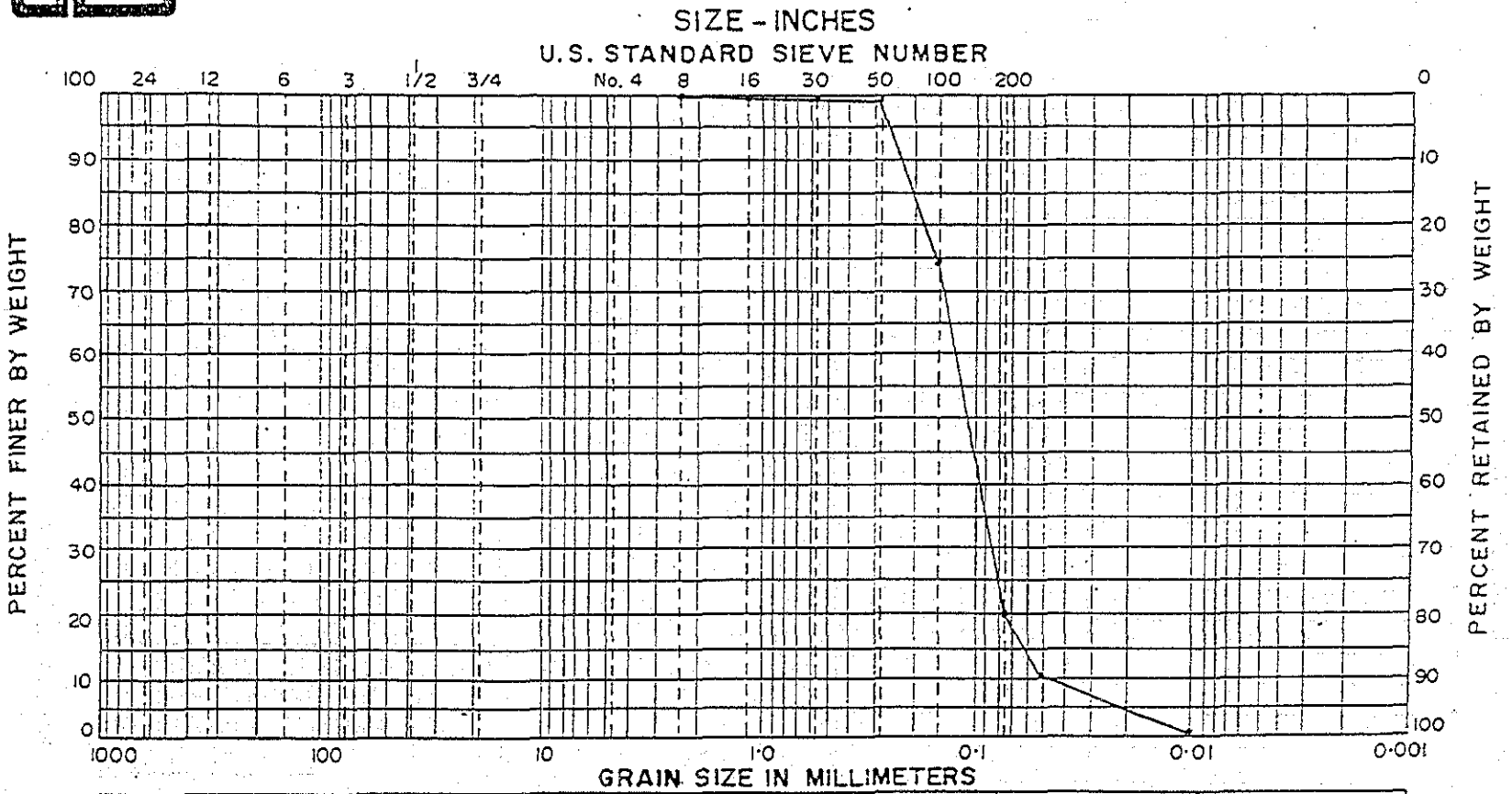


GRADATION CURVES

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



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

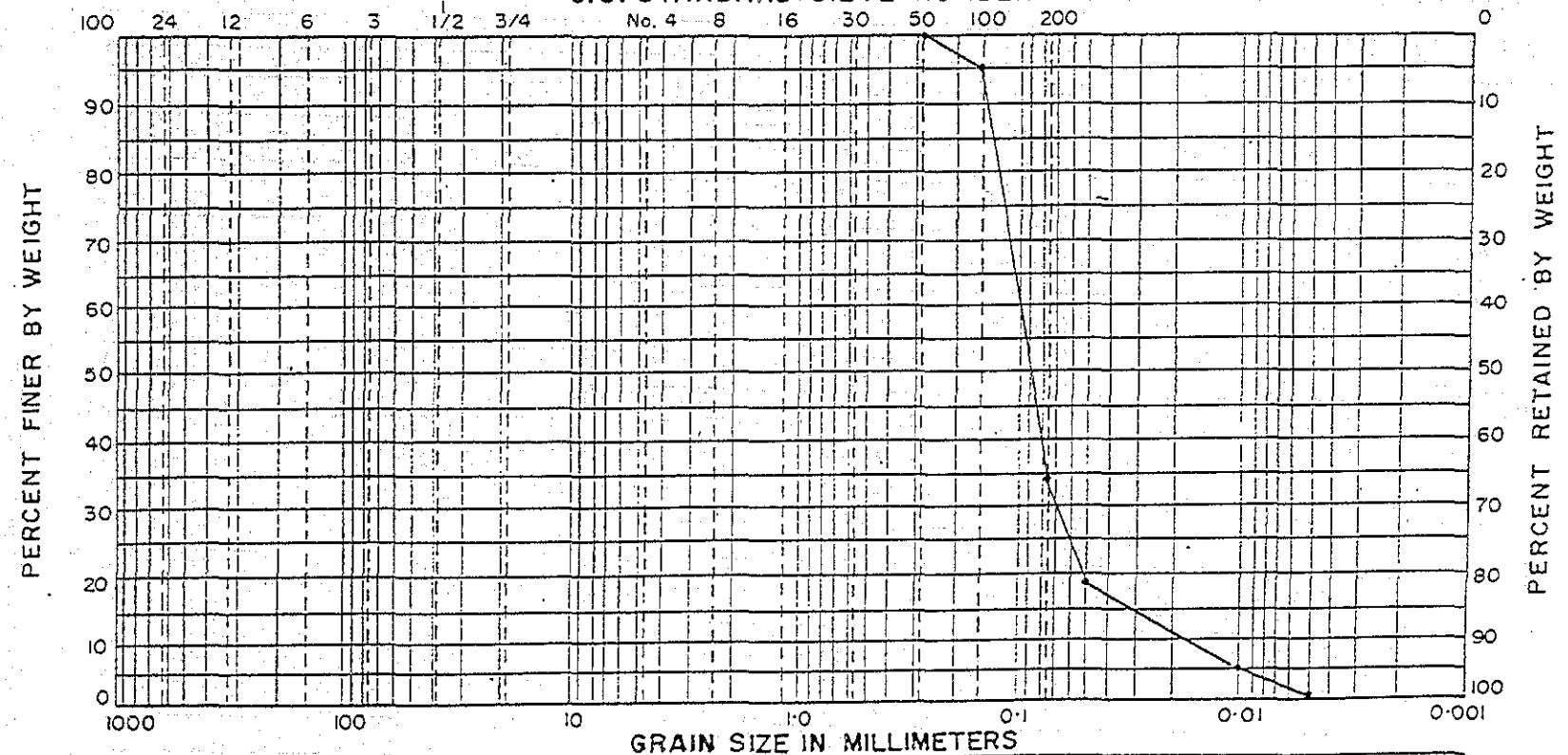
2-66

L7-C

GS

SIZE - INCHES

U.S. STANDARD SIEVE NUMBER



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

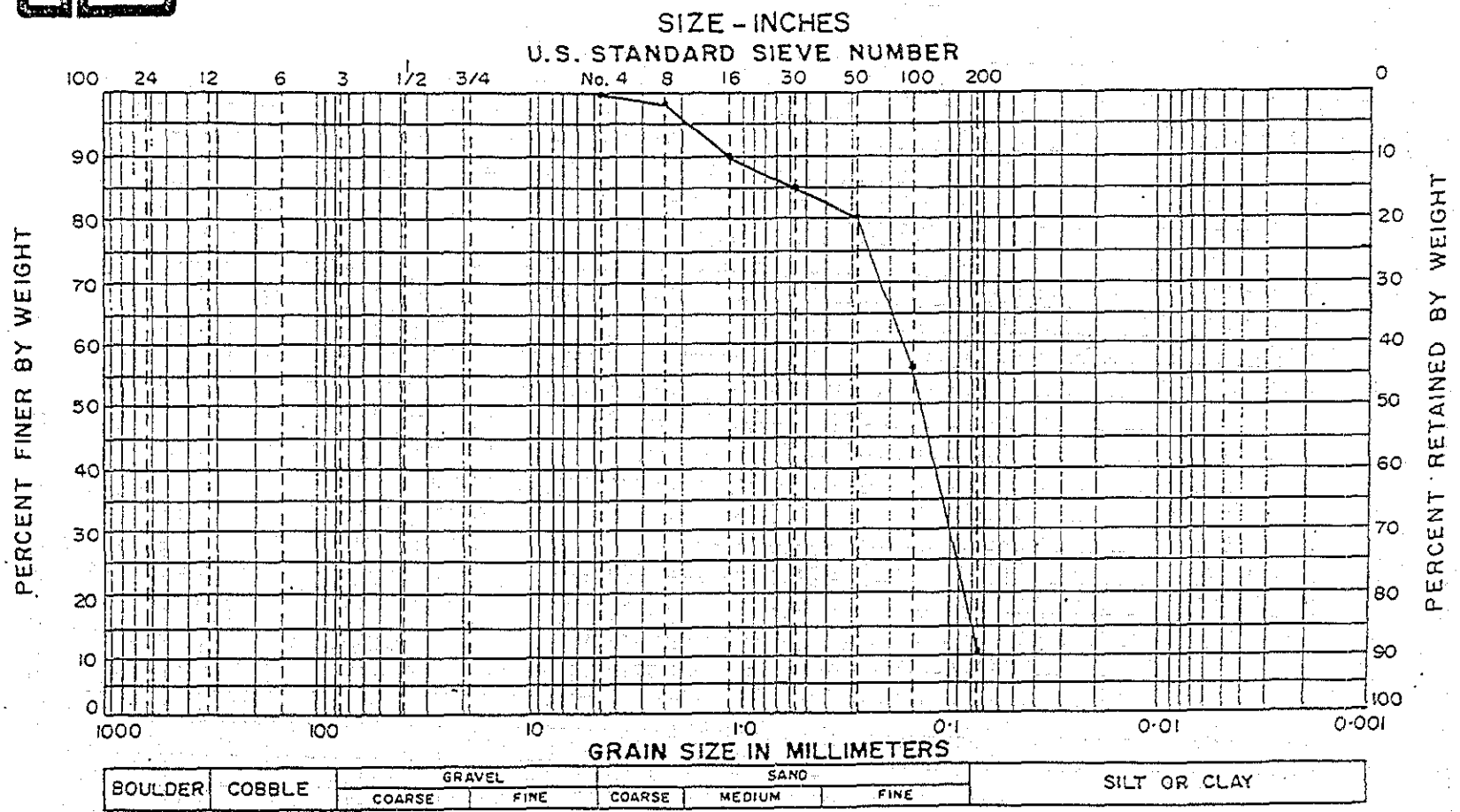
GRADATION CURVES

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

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

GCS



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

GRADATION CURVES

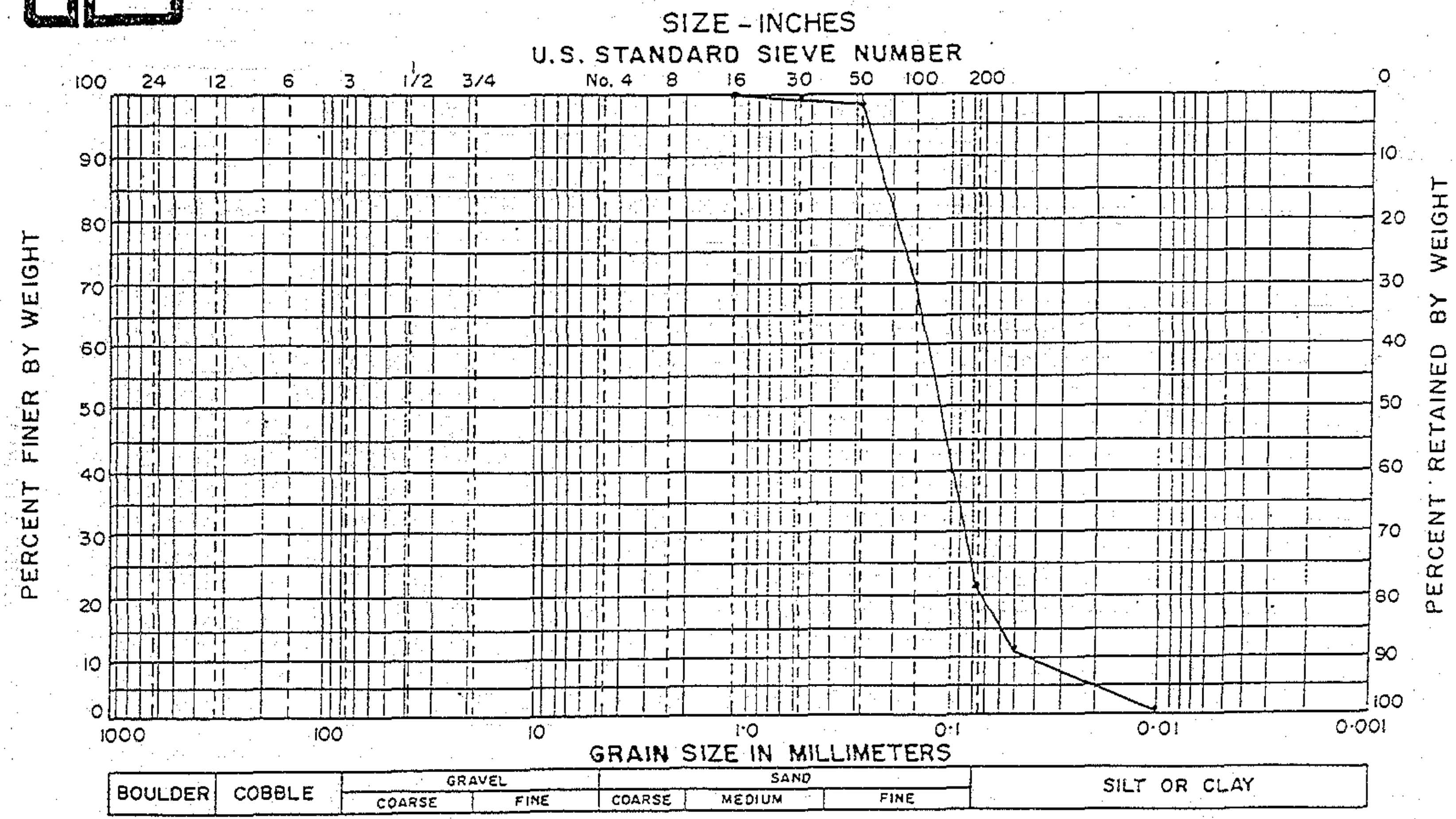
BORING/PIT NO.	SAMPLE NO	DEPTH	CLASSIFICATION	LL	PL	PI
BH-5	SPT-4	4.00m				

PROJECT COOLING WATER WAY
THERMAL POWER PLANT

LOCATION WEST WHARF

2-68

65-5

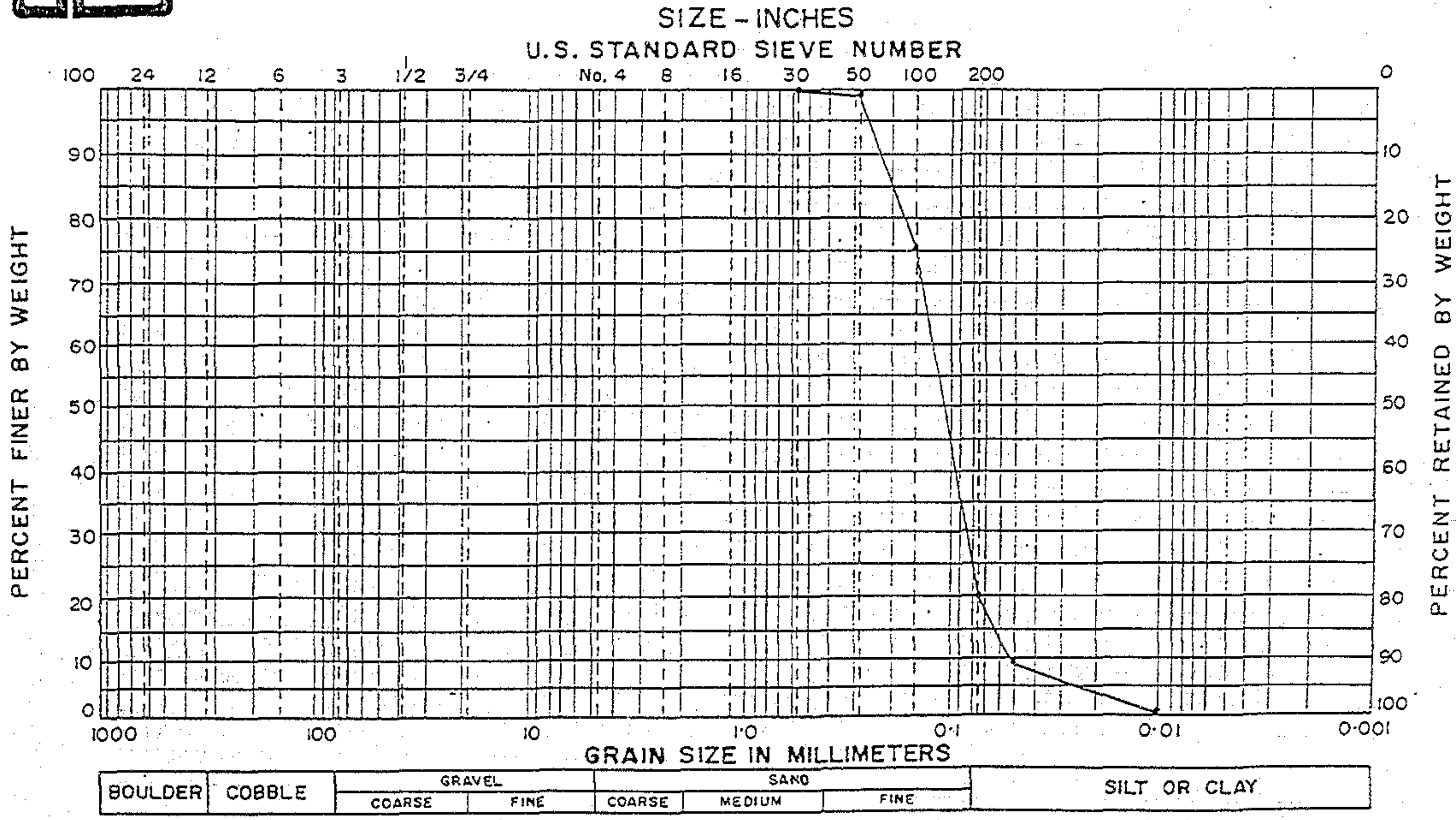


GRADATION CURVES

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



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

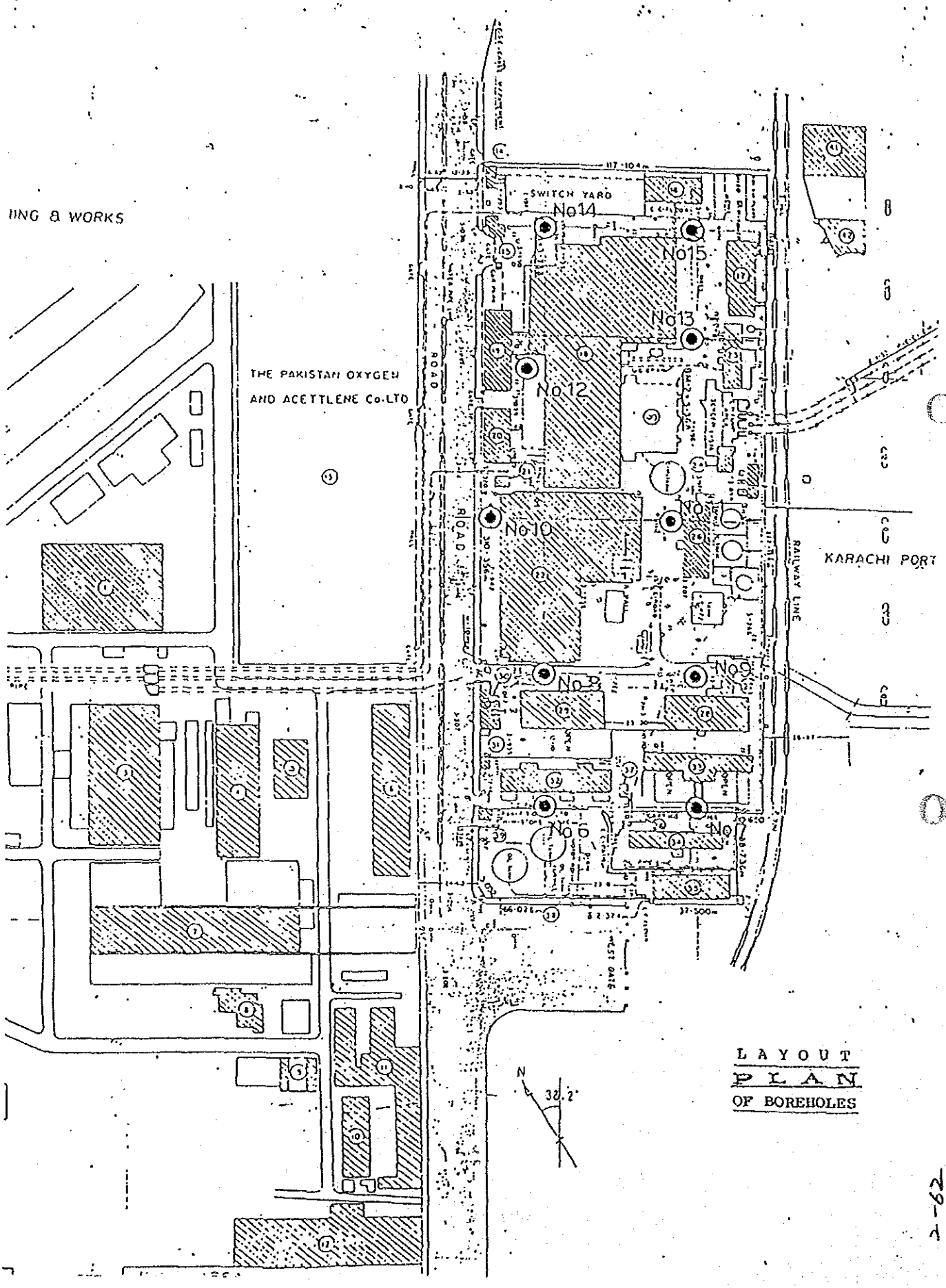
2-60

P-II

BORE LOGS

(Inside power station)

WEST WHARF STEAM POWER PLANT PROJECT



LAYOUT
PLAN
OF BOREHOLES

1-62

KESC WEST WHARF POWER PLANT

BORE LOG

BORE HOLE NO: 6

Date: 15.5.89 to 16.5.1989

Ground Elev: 3.054

Ground Water Table: 2.58m

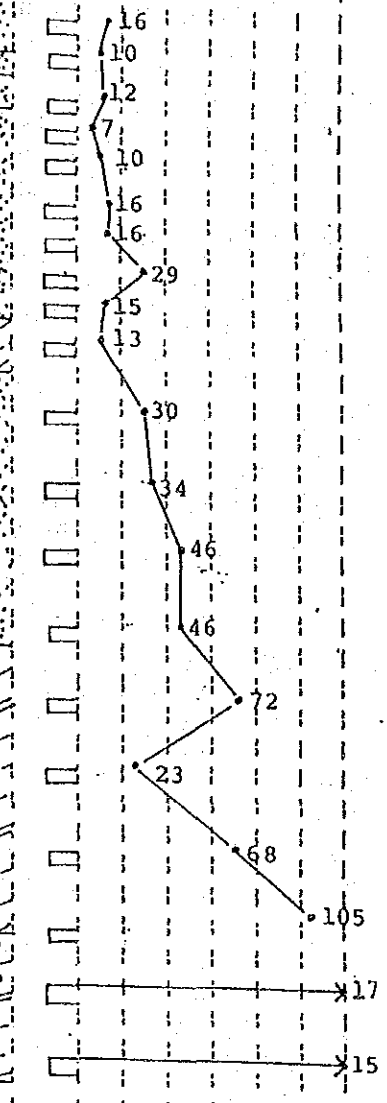
SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
	2.00	2.00	Brownish medium dense fine to med. SAND with gravel.
	2.50	0.50	
	3.50	1.00	Brownish medium dense fine SAND with shell fragments.
			Brownish medium dense medium to coarse SAND with shells.
			Greyish medium dense fine SAND with mica and shell fragments.
	9.50	6.00	
	11.00	1.50	Brownish grey stiff Silty CLAY.
			Greyish dense fine SAND with mica.
	18.50	7.50	
			Greyish very stiff to hard Silty CLAY.
	26.50	8.00	
			Brownish grey hard Silty CLAY with traces of sand and gravel.
	30.50	4.00	
			Borehole completed.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100



SPT Sample: ☐

PGEL

PENCON 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: 7

BORE LOG

Date: 14.05.1989

Ground Elev: 3.024

Ground Water Table: 2.53 m

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	2.50	2.50	Brownish grey medium dense fine SAND with mica & shell fragments.			18
3–7			Grey to brownish grey very loose to dense micaceous SAND with shell fragments.			19, 9, 2, 12, 16, 19, 31
8	8.50	6.00				
9–10	10.50	2.00	Dark grey med. dense med. to coarse SAND with shell fragments.			11, 15
11–20	20.5	10.50	Grey very loose to very dense fine SAND with traces of mica and shell fragments.			2, 9, 52, 56, 49
21–30	30.50	10.00	Greyish very stiff to hard Silty CLAY.			29, 28, 45, 31, 27
31						

SPT Sample: ☐

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

2-64

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 8

BORE LOG

Date: 28.4.89 to 29.4.89.

Ground Elev: 3.036

Ground Water Table: 2.53m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1–2	1.50	1.50	Brownish grey medium dense fine to medium SAND.
2–8	8.50	7.00	Grey loose to medium dense fine SAND with shell fragments and mica.
8–12	12.50	4.00	Grey loose to medium dense fine to medium SAND with some gravel.
12–20	20.50	8.00	Brownish grey medium dense to dense fine micaceous SAND.
20–22	22.50	2.00	Brownish very dense medium SAND.
22–29	29.00	6.50	Brownish grey hard Silty CLAY.
29–30	30.50	1.50	Brownish grey hard Silty CLAY with gravel.
30–31			Borehole completed.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

13, 5, 14, 9, 17, 14, 19, 19, 9, 15, 5, 30, 37, 21, 16, 83, 38, 34, 39, 87

SPT Sample: ☐

PGEL

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2-56

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 9

BORE LOG

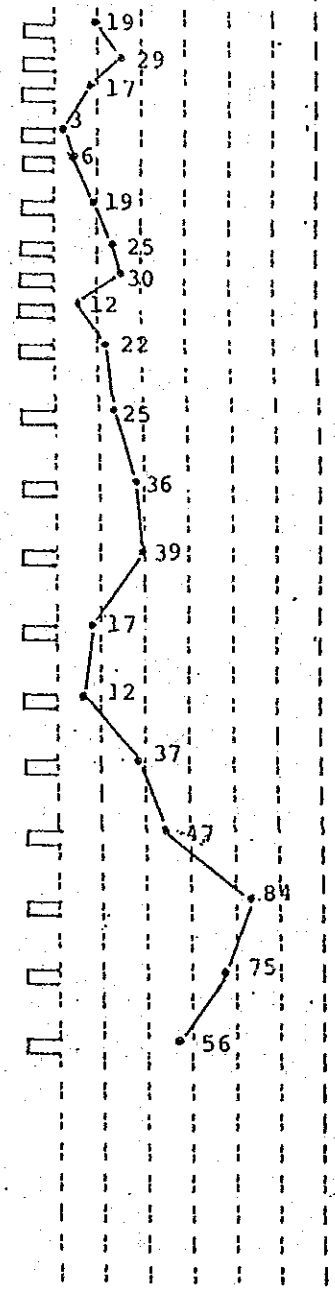
Date: 26.4.89 to 27.4.89 | Ground Elev: 3.118 | Ground Water Table: 2.80m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1–3	3.50	3.50	Brownish medium dense fine to med. SAND with traces of gravel.
4–5	5.50	2.00	Dark grey very loose to loose fine to medium micaceous SAND.
6–8	9.00	4.50	Greyish medium dense medium to fine SAND with traces of mica.
9–10	10.50	1.50	Greyish medium dense fine to medium SAND with traces of mica, gravel and shell fragments.
11–20	20.50	10.50	Grey medium dense to dense fine to medium micaceous SAND.
21–27	28.00	7.50	Brownish grey hard Silty CLAY.
28–30	30.50	2.50	Light brownish very dense silty fine SAND with traces of gravel and clay.
31			Borehole completed.

LOG | SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100



SPT Sample: ☐

PGEL

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99-2

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 10

BORE LOG

Date: 30.4.89 to 01.5.89 Ground Elev: 3.21 Ground Water Table: 2.55m

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	3.60	3.60	Brownish grey loose to medium dense fine SAND with shell fragments.			17, 4, 7, 6
4–5	5.00	1.40	Dark grey loose fine SAND with traces of shell fragments.			16
6–8	9.00	4.00	Dark grey medium dense fine SAND with mica.			27, 23, 10
9–10	10.00	1.00	Brown medium dense fine SAND with some mica.			24
11–12	12.50	2.50	Greyish dense fine to medium micaceous SAND.			32, 30
13–16	17.00	4.50	Grey medium dense to dense fine to medium micaceous SAND with shell fragments.			26, 49
17–18	19.00	2.00	Brown dense fine to medium SAND.			56
19–20	20.00	1.00	Brownish dense fine SAND with traces of clay.			43
21–30	30.50	10.50	Brownish grey to grey hard silty CLAY.			32, 35, 40, 40, 36
31			Borehole completed.			

SPT Sample: □

PGEL

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9 Sunny Side Road, Civil Lines,
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19-67

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 11

BORE LOG

Date: 23.4.89 to 24.4.89 Ground Elev: 3.231 Ground Water Table: 2.3m

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	8.00	8.00	Brownish grey to grey, loose to dense, Silty fine to medium SAND, occasional traces of coarse sand and shell fragments.			8, 9, 12, 11, 14, 32, 37, 32, 20, 39, 28, 49, 37, 74, 85
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.			10, 100, 10, 100, 79
30–31			Borehole completed.			

SPT Sample: ☐

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2-68

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 13

BORE LOG

Date: 2.5.89 to 3.5.89

Ground Elev: 3.128

Ground Water Table: 2.50m

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
21–30	30.50	10.50	Greyish brown, very stiff to hard, Silty CLAY with occasional traces of coarse sand and gravel.			40, 24, 38, 26, 34, 42
31			Borehole completed.			

SPT Sample: ☐

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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: 3.088 | Ground Water Table: 2.50m

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, 23, 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, 5
11–19	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
20–30	30.50	11.50	Grey, very stiff to hard, Silty CLAY.			12, 20, 35, 23, 12, 13
31			Borehole completed.			

SPT Sample:

PGEL
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KESC WEST WHARF POWER PLANT

BORE LOG

BORE HOLE NO: 14

Date: 4.5.89 to 10.5.89

Ground Elev: 3.143

Ground Water Table: 2.58m

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
20–24	25.00	6.00	Grey, very stiff to hard, Silty CLAY.			110, 22, 42
25–30	30.50	4.50	Brownish, very dense, silty fine SAND.			106, 51, 53
31			Borehole completed.			

SPT Sample: □

PGEL

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

3-17

KESC WEST WHARF POWER PLANT

BORE HOLE NO: 15

BORE LOG

Date: 18.4.89 to 22.4.89

Ground Elev: 3.128

Ground Water Table: 2.80m

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			Grey to dark grey, loose to medium dense, silty fine micaceous SAND with occasional shell fragments.			12, 15, 15, 4, 4, 20, 16, 8, 10
10	10.00	10.00				
11–19			Brownish grey, medium dense to very dense, fine to medium SAND with traces of silt and gravel.			16, 20, 55, 69, 52, 50, 33, 90
20	20.50	10.50				
21–29			Brownish grey, hard Silty CLAY with occasional gravel.			14, 16
30	30.50	10.00				14
31			Borehole completed.			

SPT Sample: ☐

PGEL

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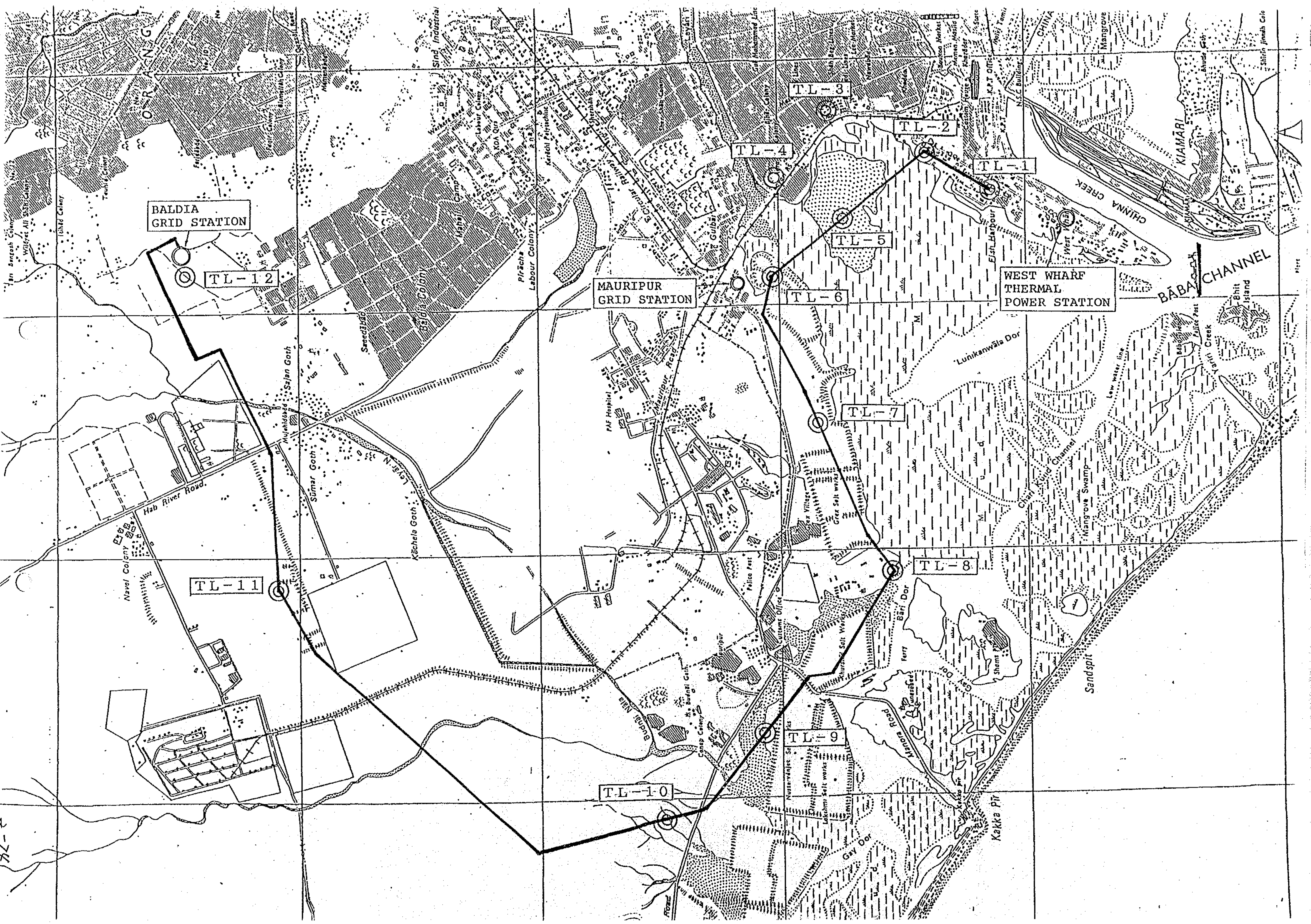
2-72

P-III

BORE LOGS

(Transmission line)



BALDIA
GRID STATION
TL-12
MAURIPUR
GRID STATION
TL-1
TL-2
TL-3
TL-4
TL-5
TL-6
TL-7
TL-8
TL-9
TL-10
TL-11
WEST WHARF
THERMAL
POWER STATION
BĀBA CHANNEL
KIAMĀRI
CHINA CREEK
Hab River Road
Mauripur Road
Sandspit
Kakka Pir
Mangrove Swamp
Lunikanwala Dor
Gay Dor
Bari Dor
Manora Road
Naval Colony
Badhai Nala
Sumar Goth
Kachela Goth
Baldia Colony
Pirācha Labour Colony

KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-1

BORE LOG

Date: 28.5.89 to 30.5.89 Ground Elev: 3.066m Ground Water Table: 3.00m

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
1-2-3	3.00	3.00	Brown, very loose, fine SAND.			2 1 2
4-5	4.00	1.00	Dark brown, decayed, soft wooden pieces.			2
6-7-8-9-10	10.50	6.50	Grey, loose, fine SAND with traces of shell fragments.			1 3 5 4 8 8
11-12	12.50	2.00	Grey, hard, Silty CLAY.			78
13-14	14.50	2.00	Grey, very dense, fine SAND.			84
15-16-17-18-19-20-21-22	22.50	8.00	Brown, very dense, fine to medium, SAND with traces of coarse SAND.			83 68 65
23-24	24.50	2.00	Brownish grey, hard, Silty CLAY.			89
25-26-27-28-29-30	30.50	6.00	Brownish grey, fine to medium, very dense SAND with traces of coarse sand and gravel.			107 110 120
31			Borehole completed.			130

SPT Sample: ☐

NB: Ground Water Table reported in all Borecharts indicate depth of water below the existing ground level.

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KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-2

BORE LOG

Date: 31.5.89 to 1.6.1989. Ground Elev: 2.860m Ground Water Table: 3.10m

SCALE (m)	DEPTH (m)	THICKNESS (m)	SOIL NAME/DESCRIPTION
1	1.50	1.50	Grey, loose, Silty, very fine SAND with traces of mica.
3	3.50	2.00	Grey, very loose to loose, sandy SILT.
4	4.50	1.00	Grey, very loose, medium to coarse SAND.
7	7.50	3.00	Grey, loose to medium dense, fine SAND with traces of Silt and shell fragments.
10			Brown, dense to very dense, medium to coarse SAND with gravel.
14	14.50	7.00	
15			Grey, hard, Silty CLAY.
18	18.50	4.00	
19			Brown, very dense, fine to medium SAND with traces of Silt.
22	22.50	4.00	
23			Grey, hard, Silty CLAY.
24	24.50	2.00	
25			Brown, very dense, medium to coarse SAND.
30	30.50	6.00	
31			Borehole completed.

LOG

SAMPLE SPT/UDS.

STANDARD PENETRATION TEST Blows/foot (N-Value)

20 40 60 80 100

1 1 9 2 3 5 29 50 60 50 50 32 15 40 70 118 180 129 105 100

SPT Sample: □

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KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-3

BORE LOG

Date: 18.6.89 to 20.6.89 Ground Elev: Ground Water Table: 2.38m

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
1-2	1.50	1.50	Brownish gray, very loose, silty fine SAND.		U	2 2
3-4	4.50	3.00	Dark gray, soft, clayey SILT.		U	2
5-6	6.00	1.50			U	16
7	7.50	1.50	Dark gray, very stiff, silty CLAY with traces of organic matters.		U	13
8	8.50	1.00			U	23
9-11			Grayish brown, medium dense, silty fine SAND with traces of coarse sand and clay.		SPT	16 45 75
12	12.50	4.00			SPT	76
13-14	14.50	2.00	Brown, very dense, gravelly coarse SAND.		SPT	30
15-16	16.50	2.00	Grayish brown, medium dense to very dense, Sandy SILT with occasional concretions.		SPT	50
17-20			Brown, dense, silty coarse SAND with traces of clay.		SPT	67
21	21.00	4.50			SPT	50
22-23			Brownish gray, hard, Silty CLAY.			
24-27			Brown, very dense, Sandy SILT with traces of Clay, coarse Sand and concretions.			
28-38			Brown, hard, well cemented, coarse grained SANDSTONE.			
39-40	40.00	19.00				
41-42			Borehole completed.			

SPT Sample: ▭

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KESC WEST WHARF - Transmission Line.

BORE LOG

BORE HOLE NO: TL-4

Date: 21.6.89 to 22.6.89

Ground Elev:

Ground Water Table: 2.89m

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
1-2-3-	3.00	3.00	Grayish brown to brown, very loose to medium, dense silty fine SAND with traces of coarse sand and concretions.			3, 18, 22
4-5-6-7-	7.50	4.50	Brown, medium dense, gravelly coarse to fine SAND with traces of Silt.			16, 9, 16
8-9-10-11-	10.50	3.00	Brown, very dense, silty fine SAND with traces of gravels.			75, 62, 71
12-13-14-15-16-17-			Brown, hard, Silty CLAY.			76, 57, 60
18-	18.50	8.00				135
19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-			Brown, hard, well cemented coarse grained SANDSTONE.			
40-	40.00	21.50				
41-42-			Borehole completed.			

SPT Sample: ☐ ▨

PGEL

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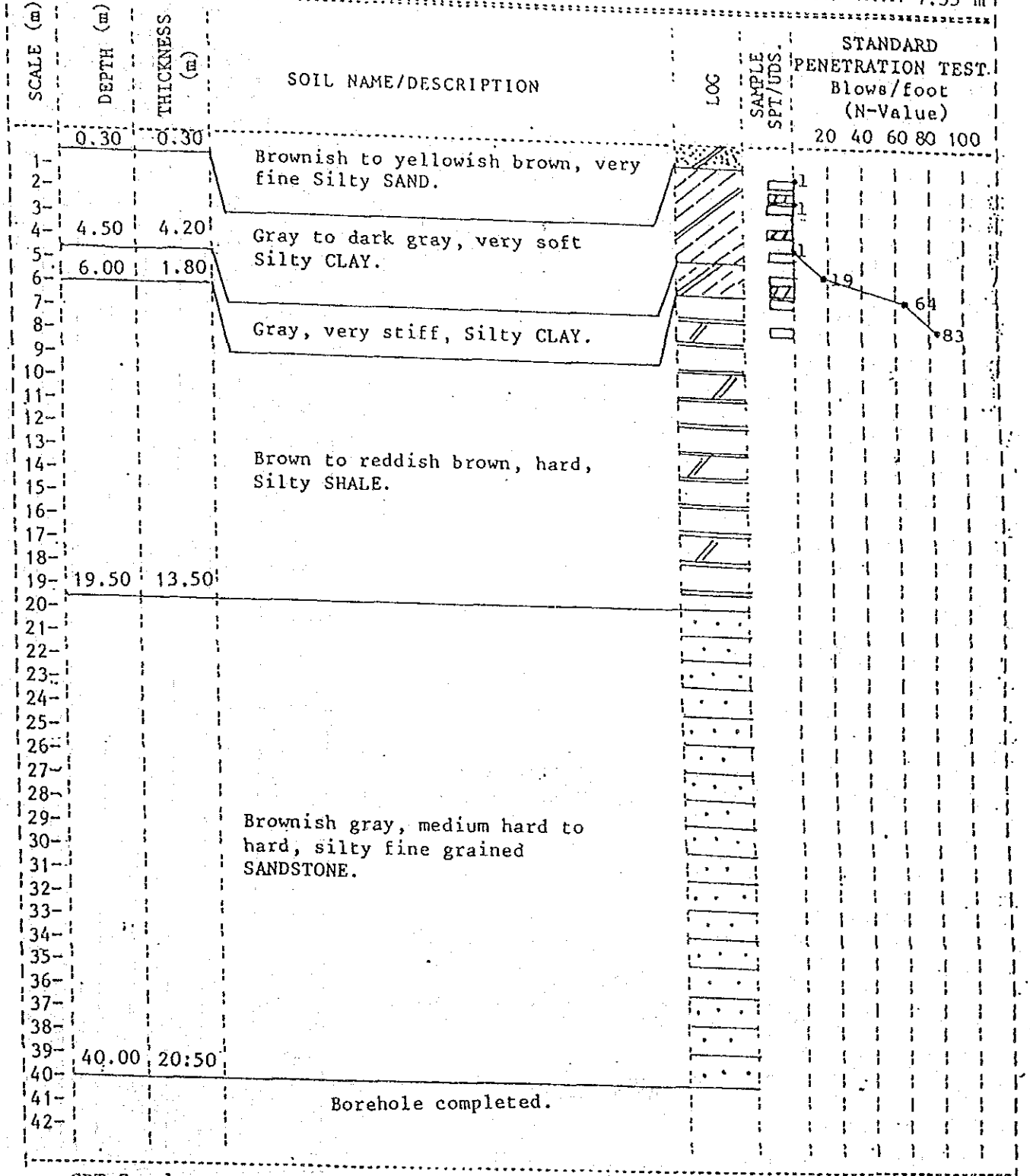
R-2

KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-5

BORE LOG

Date: 9.6.89 to 14.6.89 | Ground Elev: 0.965m | Ground Water Table: 1.35 m



SPT Sample: ☐
UDS Sample: ▨

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KESC WEST WHARF - Transmission Line.

BORE LOG

BORE HOLE NO: TL-6

Date: 24-6-89 to 26-6-89

Ground Elev: 2.062m

Ground Water Table: 1.5 m

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	1.40	1.40	Brown, medium dense, silty, medium to coarse SAND.			20
2-3	2.60	1.20	Brown, dense, weakly cemented, gravelly coarse SAND with silt.			60 (3")
3-4						43
4-5						61
5-6						71
6-7						60 (6")
7-8						
8-9						
9-10						
10-11						
11-12			Brown to reddish brown, hard, Silty SHALE.			
12-13						
13-14						
14-15						
15-16						
16-17						
17-18						
18-19						
19-20						
20-21						
21-22	22.50	19.50				
22-23						
23-24						
24-25						
25-26						
26-27						
27-28			Gray to brownish gray, hard, silty fine grained SANDSTONE.			
28-29						
29-30						
30-31						
31-32						
32-33						
33-34	34.00	11.50				
34-35						
35-36						
36-37						
37-38			Reddish brown, hard, fragmented, silty SHALE.			
38-39						
39-40	40.00	6.00				
40-41			Borehole completed.			
41-42						

SPT Sample: ☐

PGEL

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GE-7

KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL - 7

BORE LOG

Date: 29.6.89 to 30.6.89 | Ground Elev: 2.579m | Ground Water Table: 2.0m

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	1.00	1.00	Brownish gray, very dense, silty fine SAND with gravel (weakly cemented).			59
2-3	2.50	1.50				44
4-5	5.00	2.50	Brownish grey, dense, fine to medium SAND with silt.			28 42 56 78 90
6-10			Brown, very stiff to hard, Silty CLAY, fissile, shaly.			
11-39			Brown, hard, Silty SHALE.			
39-40	40.00	35.00				
41-42			Borehole completed.			

SPT Sample: ☐

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13-V

KESC WEST WHARF - Transmission Line.
(within Marine Academy)

BORE LOG

BORE HOLE NO: TL-8

Date: 8.7.89 to 9.7.89 | Ground Elev: 1.060m | Ground Water Table: 1.20m

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
1-2-3-4-5-6-7-8-	2.45	2.45	Brown, dense, occasionally weakly cemented, gravelly, Silty, coarse SAND with traces of fine Sand.			
	8.50	6.00	Light brown, hard, well cemented, CONGLOMERATE.			
9-10-11-12-13-14-15-16-17-18-	19.00	10.50	Brown to dark brown, hard laminated CLAYSTONE/Silty SHALE.			63 (3") 67 (2½")
19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-	40.00	21.00	Brown, medium hard to hard, fine grained SANDSTONE.			
40-41-42-			Borehole completed.			

SPT Sample: ☐

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2-92

KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-9

BORE LOG

Date: 3.7.89 to 5.7.89 Ground Elev: 1.38m Ground Water Table: 0.30m

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
1-2-3	2.00	2.00	Brown, loose, medium to coarse SAND with traces of gravel.			8
3-4-5-6-7	3.00	1.00	Gray, very dense, medium to fine, weakly cemented SAND.			52 / 48
8-9-10-11-12	12.00	9.00	Grey, medium hard to hard, silty fine grained SANDSTONE with thin layers of hard Siltstone.			
13-14-15-16-17-18	18.00	6.00	Brown, hard, brittle, Silty SHALE.			
19-20-21-22-23-24	24.00	6.00	Gray, hard, silty, fine to medium grained SANDSTONE.			
25-26-27-28-29-30-31-32-33	33.00	9.00	Grayish brown hard silty SHALE.			
34-35-36-37-38-39-40	40.00	7.00	Gray, hard, silty fine grained SANDSTONE.			
41-42			Borehole completed.			

SPT Sample: ☐

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

KESC WEST WHARF - Transmission Line.

BORE HOLE NO: T·L – 10

BORE LOG

Date: 6.7.89 to 7.7.89 | Ground Elev: 3.480m | Ground Water Table: 2.90m

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
1–2–3–	0.30	0.30	Brownish gray, dense, silty coarse SAND with occasional gravel.			60 (3") 60 (2½") 60 (2")
4–5–6–7–	4.00	3.50	Brownish gray, very dense, silty coarse SAND with gravel.			47 71 87
8–9–10–11–12–13–14–15–16–17–18–19–	20.00	16.00	Brown, hard, silty SHALE.			
20–			Borehole completed			
21–22–23–24–25–26–27–28–29–30–31–						

SPT Sample: ☐

PGEL
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KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-11

BORE LOG

Date: 1.7.89 to 2.7.89 Ground Elev: 27.374m. Ground Water Table: Not Encountere

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	0.50	0.50	Dark brown, dense, sandy SILT.			60(3") 63(2½")
2						
3						
4						
5						
6			Brown, very dense/hard, coarse SAND with gravel, weakly cemented.			
7						
8						
9						
10	10.00	9.50				
11						
12						
13						
14						
15			Brown, moderately hard to hard CONGLOMERATE (gravelly coarse SAND with occasional boulders and traces of hard clay in matrix).			
16						
17						
18						
19						
20	20.00	10.00				
21			Borehole completed.			
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

SPT Sample: ☐

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KESC WEST WHARF - Transmission Line.

BORE HOLE NO: TL-12

BORE LOG

Date: 27.6.89 to 28.7.89 Ground Elev: 54.263m Ground Water Table: Not Encountered

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	Grayish brown, dense, sandy SILT.			37 52 (6")
2–20	20.00	18.00	Light brown, fractured, LIMESTONE (slightly weathered at the top).			
20–31			Borehole completed.			

SPT Sample: □

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9 Sunny Side Road, Civil Lines,
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10. 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. 43°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	

(8) Design seismic force

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

Ci = Z Rt Al 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
54S.L (Mean Sea Water Level)	EL + 1.64 m

L.L.W.L (Lower 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) Environmental protection

(a) Air (SOx and NOx)

The World Bank recommended standards shall be refered to and also Japanese standard is applicable.

(b) Waste water

Neutralization treatment shall be provided.

(c) Noise

	Noise level (dB(A))	Distance from Equipment (m)
Boundary line of the Site	70	-
Indoor Equipment	90	1
Outdoor Equipment	90	1
Central control room and office room	60	-

(14) Quality of drinking water

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

(15) Sand storm

The wind usually carries sand and salt.

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

11. 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.

So for 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.

2-90

12. ERECTION

(1) Prior to erection work, the Contractor shall conduct through research and investigation on preliminary work methods, safety, and schedule so that the erection work can be smoothly conducted and the erected plant can exhibit the expected performance.

(2) The Contractor shall assign the Contractor's representative at the job site from the beginning through to the completion of the Works. The Contractor's representative shall be given the authority effective during the period of work which allows him to take all the necessary emergency measures so as to execute the said work. However, the Contractor's representative shall be approved by the Owner.

(3) The Contractor's representative shall supervise quality control, safety control and maintenance of the facilities with a strong sense of responsibility. He shall also be responsible for retaining order and preventing trouble at the job site.

(4) In case the Owner and/or the Engineer determines that the Contractor's representative is unsuitable for the position, the person shall be replaced at his own cost. When the Contractor's representative is absent from the job site for two (2) weeks or more for a business trip or other reasons, an approval of such shall be obtained from the Owner and a proxy shall be assigned during this period.

(5) With regard to equipment, instruments and materials, special care shall be exerted when transporting, handling and storing

the said items in order to prevent loss and damage.

(6) The Contractor shall closely consult with the Owner and the Engineer about such matters as erection, installation, adjustment and inspection of equipment and materials. The Contractor's representative shall keep in close contact with and fully cooperate with the Owner and the Engineer, and shall exert his utmost efforts to conduct the said work in a proper and satisfactory manner.

(7) In case inconvenience or trouble occurs in relation to other facilities or work in progress during the installation work, the Contractor shall report to the Owner and the Engineer and shall then, under the coordination of the Owner and the Engineer, conclude an agreement with the other contractor(s) of the work(s) in a manner that all work(s) can be conducted without trouble.

(8) The Contractor shall exert every effort to keep things in order so as to prevent accidents at the job site and to facilitate smooth progress of the Works. After the work is completed, scaffolding and related materials and machines employed for executing the work shall be removed immediately, and the job site shall be cleaned and put in proper order.

(9) The Contractor shall exercise extreme care to prevent any fire whatsoever, particularly at the job site or at the workmen's quarters.

(10) The Contractor shall assign a full-time electrical engineer at the job site so as to ensure the security of the power line used for the work. A monthly schedule water consumption,

working power and power consumption shall be submitted to the Owner and the Engineer.

(11) Waste oil, dust, trash and other such material which accumulate as the work progresses shall be disposed of in a manner approved by the Owner and the Engineer.

(12) Prior consultation shall be conducted to prevent accidents which might otherwise occur between two different working levels. Such consultation between and/or among other contractors shall be conducted in the presence of the Owner and the Engineer.

(13) Should human accident, facility accident, public nuisances or other emergencies develop in relation to the work, appropriate emergency measures shall be taken immediately, and the accident shall be reported to the Owner and the Engineer at once.

(14) Should the Contractor employ a subcontractor(s), the Contractor shall submit a report describing the background and experience of the subcontractor(s) to the Owner and the Engineer for approval.

(15) The Contractor's representative and/or related persons shall attend the periodic meetings which are to be held by the Owner and the Engineer during the progress of the work so as to discuss the work method and progress.

(16) The Contractor shall prepare all temporary materials required for erection work.

(17) The Contractor shall submit a work report (number of persons by job, contents of work, etc.) to the Owner and the

Engineer daily.

(18) The Contractor shall submit the installation specifications and/or procedures to the Owner and the Engineer for approval.

(19) All welders shall be qualified in the handling skills of specified materials, and the Contractor shall submit their certificate of qualifications to the Owner and the Engineer.

(20) The welding rods shall be carefully boxed and sufficiently protected from damage caused by high humidity during shipment and storage at the Site.

The Contractor shall take measures to prevent incorrect use of welding rods by welders during construction works in the field.

(21) All consumables such as chemicals, lubricants, fuses, lamps, etc., required for the work up to the point of Taking Over of the Power Plant shall be supplied by the Contractor.

(22) The Owner and the Engineer have the right to inspect and approve each stage of the work so as to ensure smooth work progress and completion.

(23) All works regarding the supply and setting of materials, equipment and related facilities as well as the necessary foundations for drum lifting, generator stator pole up/lift up, deaerator and feedwater heater lifting shall be prepared by the Contractor.

The generator stator shall be carried into the main building by the pole-up or lift up method through the opening of wall