Program Management Unit (PMU)
Municipal Services Delivery Program (MSDP)
P&D Department, Government of Sindh

Sindh Municipal Services Delivery Program (MSDP)

CONTRACT PACKAGE AWW-01 (ZONE-A)

REHABILITATION/STRENGTHENING OF OXIDATION PONDS (ZONE A, B & D)

BIDDING DOCUMENTS
(Single Stage Single Envelope)

VOLUME- I A

NOTICE INVITING TENDER
INSTRUCTIONS TO BIDDERS
BIDDING DATA
FORMS
FORM OF BID & APPENDICES TO BID INCLUDING BOQ
CONDITIONS OF CONTRACT
INCLUDING QUALIFICATION CRITERIA

APRIL-2023

Issued to: **Dated: _____2023**

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INVITATION FOR BID

Notice Inviting Tender
(Single Stage – One Envelope Procedure of SPPRA)

Rehabilitation/ Strengthening of Oxidation Ponds (Zone A, B & D) in Jacobabad (Contract Package AWW-01)

1. The Program Management Unit (PMU), Sindh MSDP; P&D Department, Government of Sindh has received a grant from the USAID towards the cost of improvement of water supply, waste water & solid waste infrastructure at Jacobabad, leading to measurable improvement of governance and health outcomes and it is intended that part of the proceeds of the payment to be made in collaboration of Government of Sindh will be applied to eligible payments under the contract for the following contract packages:

CONSTRUCTION TENDER

Contract Package	PEC License (in addition to eligibility & qualification criteria included in Bidding Documents)	Estimated Cost	Bid Securities
REHABILITATION/STRENGTHENING OF OXIDATION PONDS (ZONE A, B & D) AT JACOBABAD. (CONTRACT PACKAGE AWW-01 (ZONE-A))	**PEC License (C-5 or above with Specialization in CE – 09, CE – 10).**	**The Estimated cost for Contract Package is Rs.51.236 Million**	**2% of Bid Price, either in the shape of Call Deposit, Demand Draft/Pay Order or Bank Guarantee in favor of "The Program Director, Sindh MSDP" to be furnished. (Refer Biding Data)**

2. The PMU, USAID- Sindh MSDP invites all interested contracting firms (Joint Ventures/ Consortium may be allowed) having experience as per qualification criteria. Following is the schedule for the above tenders.

Schedule	Date & Time	Venue
Issuance of Tender	**From Wednesday-12th April, 2023 (During Working Hours) To Tuesday-2nd May, 2023 (on or before 10:00 am)**	**Office of the Program Director, PMU, MSDP D-18, Block -2, Clifton, Karachi, Ph:021-35810017-18**
Dropping of Tender	**Up to Tuesday-2nd May, 2023, on or before 12:30 Pm**	
Opening of Tender	**On Tuesday-2nd May, 2023, @ 01:30 Pm**	

3. The interested participants may obtain further information including Qualification Criteria and acquire the complete set of Bidding documents from the following office of the Procuring Agency during working hours as per the schedule given above, on submission of a written application personally or through authorized representative from the above office on payment of a fees of Rs.3000/- (non-refundable) in shape of **VALID** Call Deposit/Pay Order/Demand Draft in favor of **The Program Director , Sindh MSDP**. In other case the tender documents can be downloaded from SPPRA /(PPMS) & MSDP website www.pprasindh.gov.pk & https://msdp.sindh.gov.pk/ can be dropped on the given date & time place in this NIT along with a pay order/call deposit/demand draft of tender cost as mentioned above otherwise tender will be rejected. All Pay orders should have validity of at least 04 Months from the day of submission to MSDP. Please note that the bidding documents will not be sent through post/courier.

4. The tenders in sealed covers mentioning name of work should be dropped at the place and time mentioned above.
5. National Competitive Bidding Method (NCB) with Single Stage One Envelope Procedure will be adopted as mentioned in Bidding Data. The **Mandatory** technical evaluation shall be made on the basis on eligibility and

qualification criteria included in the bidding documents. Those bids which will comply all criteria to be consider for financial evaluation.

6. In case the date of opening or last date of sale/ submission & opening is declared as a public holiday by the Government or non-working day due to any reason, the next working day shall be deemed to be the date for last date of sale/ submission and opening of tenders accordingly. The time and venue shall remain the same.
7. The Bid Documents to be prepared in accordance with the instructions in the Bidding Documents and accompanied with bid security of **2% of Bid Price** in Pak Rupees with the Bid in sealed envelope, either in the shape of Call Deposit, Demand Draft/Pay Order or Bank Guarantee in favor of **"The Program Director, Sindh MSDP"**. This is mandatory otherwise the Bid shall not be accepted.
8. Bids will be opened in presence of the bidders or their authorized representatives who choose to attend at the same address.
9. Canvassing in connection with tendering is strictly prohibited and proposals submitted by the contractors who are reported to be involved in canvassing are liable for rejection.
10. The proposals received in unsealed covers will not be entertained and no proposal will be received after schedule date and time.
11. In case, due to any reason, no tenders against any of the above items are received on the above dates then the last date of sale, submission and opening will be 02nd May, 2023 the time & venue will remain same as mentioned in this NIT.
12. Procuring agency reserves right to annul the bidding process and reject all bids or proposals, as per SPP Rules 2010 (Updated APRIL, 2022).

Director General (Works)
MSDP Sindh-USAID
House No. D-18, Block-2,
Kehkashan, Clifton, Karachi

INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

(Note: These Instructions to Bidders along with bidding data will not be part of the Contract and will cease to have effect once the contract is signed.)

A. GENERAL

IB.1 Scope of Bid

1.1 Procuring agency as defined in the bidding data hereinafter called "the Procuring Agency" wishes to receive bids for the construction and completion of works as described in these bidding documents, and summarized in the bidding data hereinafter referred to as the "Works".

1.2 The successful bidder will be expected to complete the works within the time specified in Appendix-A to Bid.

IB.2 Source of Funds

2.1 Procuring Agency has received/ allocated/ applied for loan/ grant/ Federal/ Provincial/ Local Government funds from the source(s) indicated in the bidding data in various currencies towards the cost of the project/scheme specified in the bidding data, and it is intended that part of the proceeds of this loan/grant/funds will be applied to eligible payments under the contract for which these bidding documents are issued.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all interested bidders who are eligible under provisions of Sindh Public Procurement Rules as mentioned below and the criteria given in the Notice Inviting Tender (NIT)/ Bidding Document.

Firms and individuals, national or international, may be allowed to bid for any project where international competitive bidding is feasible. Any conditions for participation shall be limited to those that are essential to ensure the bidders capability to fulfill the contract in question.

(a) Bidders may be excluded if;
   (i) as a matter of law or official regulations, commercial relations are prohibited with the bidder's country by the federal government in case of ICB , or
   (ii) a firm is blacklisted/ debarred by the procuring agency and the matter has been reported to the Authority, subject to Rule 30 of Sindh Public Procurement Rules 2010.

(b) Government-owned enterprises or institutions may participate only if they can establish that they are;
   (i) legally and financially autonomous, and
   (ii) operate under commercial law.

Provided that where government-owned universities or research centers in the country are of a unique and exceptional nature, and their participation is critical to project implementation, they may be allowed to participate; and

Bidders shall include all those contractors who are registered or incorporated in Pakistan, irrespective of the nationality of their owners and professional staff, or

(c) Bidders are:-

(i) Pre-qualified with procuring agency for particular project/scheme;

(ii) Registered with Pakistan Engineering Council in Particular category and discipline

(iii) Registered with relevant tax authorities (income/ sales tax, wherever applicable).

IB.4 One Bid per Bidder

4.1 Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid (other than alternatives pursuant to Clause IB.16) will be disqualified.

IB.5 Cost of Bidding

5.1 The bidders shall bear all costs associated with the preparation and submission of their respective bids, and the procuring agency will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

IB.6 Site Visit

6.1 The bidders are advised to visit and examine the site of works and its surroundings and obtain all information that may be necessary for preparing the bid and entering into a contract for construction of the works. All cost in this respect shall be at the bidder's own expense.

6.2 The bidders and any of their personnel or agents will be granted permission by the procuring agency to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the bidders, their personnel and agents, will release and indemnify the procuring agency, his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expense and incurred as a result of such inspection.

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents (SSP RULE 21)

7.1 The bidding documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any addenda issued in accordance with Clause IB.9

a. Instructions to Bidders
b. Bidding Data
c. General Conditions of Contract , Part – I (GCC)
d. Special Conditions of Contract, Part- II (SCC)
e. Specifications
f. Form of Bid and Appendices to Bid
g. Bill of Quantities (Appendix D to Bid)
h. Form of Bid Security
i. Form of Contract Agreement
j. Forms of Performance Security, Mobilization Advance Guarantee, Integrity Pact and Indenture Bond for secured advance.
k. Drawings.

7.2 The bidders are expected to examine carefully the contents of all the above documents. Failure to comply with the requirements of bid submission will be at the bidders own risk. Pursuant to Clause IB.26, bids which are not substantially responsive to the requirements of the Bidding Documents will be rejected.

IB.8 Clarification of Bidding Documents (SSP RULE 23(1)):

8.1 Any interested bidder requiring any clarification(s) in respect of the bidding documents may notify the procuring agency in writing at the procuring agency's address indicated in the Invitation for Bids/NIT. Procuring agency will respond to any request for clarification provided they are received at least five calendar days prior to the date of opening of bid. Provided that any clarification in response to query by any bidder; shall be communicated to all parties who have obtained bidding documents.

IB.9 Addendum/Modification of Bidding Documents:

9.1 At any time prior to the deadline for submission of bids, the procuring agency may, for any reason, whether at his own initiative or in response to a clarification requested by a interested bidder, modify the bidding documents by issuing addendum..

9.2 Any addendum thus issued shall be part of the bidding documents pursuant to sub-clause IB 7.1 hereof and shall be communicated in writing to all bidders. Interested bidders shall acknowledge receipt of each addendum in writing to the procuring agency.

9.3 To afford bidders reasonable time in which to take an addendum into account in preparing their bids, the procuring agency may extend the deadline for submission of bids in accordance with IB.20.

C. PREPARATION OF BIDS

IB.10 Language of Bid

10.1 The bid and all correspondence and documents related to the bid exchanged by a bidder and the procuring agency shall be in the language stipulated in the bidding data and Special Conditions of the Contract. Supporting documents and printed literature furnished by the bidders may be in any other language provided the same are accompanied by an accurate translation of the relevant parts in the bid language, in which case, for purposes of evaluation of the bid, the translation in bid language shall prevail.

IB.11 Documents Accompanying the Bid

11.1 Each bidder shall:

(a) submit a written authorization on the letterhead of the bidding firm, authorizing the signatory of the bid to act for and on behalf of the bidder;

(b) update the information indicated and listed in the bidding data and previously submitted with the application for prequalification, and continue to meet the minimum criteria set out in the prequalification documents, which as a minimum, would include the following:

(i) Evidence of access to financial resources along with average annual construction turnover;
(ii) Financial predictions for the current year and the following two years, including the effect of known commitments;
(iii) Work commitments since prequalification;
(iv) Current litigation information and
(v) Availability of critical equipment
And

(c) furnish a technical proposal taking into account the various Appendices to Bid specially the following:

Appendix - E to Bid	Proposed Construction Schedule
Appendix - F to Bid	Method of Performing the Work
Appendix - G to Bid	List of Major Equipment
Appendix - K to Bid	Organization Chart for Supervisory Staff

and other pertinent information such as mobilization Programme etc.

11.2 Bids submitted by a joint venture of two (2) or more firms shall comply with the following requirements:

(a) one of the joint venture partners shall be nominated as being in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners;

(b) the bid, and in case of a successful bid, the Form of Contract Agreement shall be signed by the authorized partner so as to be legally binding on all partners;

(c) the partner-in-charge shall always be duly authorized to deal with the Procuring Agency regarding all matters related with and/or incidental to the execution of works as per the terms and Conditions of Contract and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;

(d) all partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the contract in accordance with the contract terms and a statement to this effect shall be included in the authorization mentioned under Sub-Para (a) above as well as in the Form of Bid and in the Form of Contract Agreement (in case of a successful bid);

(e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the Procuring Agency;

(f) submission of an alternative Letter of Intent to execute a Joint Venture Agreement shall be mandatory.

11.3 Bidders shall also submit proposals of work methods and schedule, in sufficient detail to demonstrate the adequacy of the bidders' proposals to meet the technical Specification and the completion time referred to sub- clause IB-1.2 hereof.

IB.12 Bid Prices

12.1 Unless stated otherwise in the bidding documents, the contract shall be for the whole of the works as described in IB 1.1 hereof, based on the unit rates or prices submitted by the bidder or percentage quoted above or below on the rates of Composite Schedule of Rates (CSR), as the case may be.

12.2 The bidders shall fill in rates and prices for all items of the works described in the Bill of Quantities. Items against which no rate or price is entered by a bidder will not be paid for by the procuring agency when executed and shall be deemed to be covered by rates and prices for other items in the Bill of Quantities. In case of Composite Schedule of Rates, if the bidder fails to mention the percentage

above or below, it shall be deemed to be at par with the rates of Composite Schedule of Rates.

12.3 The bid price submitted by the contractor shall include all rates and prices including the taxes. All duties, taxes and other levies payable by the contractor under the contract, or for any other cause during the currency of the execution of the work or otherwise specified in the contract as on the date seven days prior to the deadline for submission of bids.

Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 13.7 of the General Conditions of Contract Part-I.

12.4 The rates and prices quoted by the bidders are subject to adjustment during the performance of the contract in accordance with the provisions of Clause 13.8 of GCC. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause. Adjustment in prices quoted by bidders shall be allowed as per Appendix-C to bid.

IB.13 Currencies of Bid and Payment

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the works supplied from outside the procuring agency's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. The proportion of the bid price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in the bid.

13.2 The rates of exchange to be used by the bidder for currency conversion shall be the selling rates published and authorized by the State Bank of Pakistan prevailing on the date, 07 (seven) days prior to the deadline for submission of bids. For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the contract.

IB.14 Bid Validity

14.1 Bids shall remain valid for the period stipulated in the bidding data from the date of opening of bid specified in clause IB.23

14.2 In exceptional circumstances, prior to expiry of the original, the procuring agency may request the bidders to extend the period of validity for a specified additional period, which shall not be for more than one third of the original period of bid validity. The request and the responses thereto, shall be made in writing. A bidder may refuse the request without the forfeiture of the bid security. In case, a bidder agreed to the request, shall not be required or

permitted to modify the bid, but will be required to extend the validity of the bid security for the period of the extension, and in compliance with Clause IB.15 in all respects.

IB.15 Bid Security

15.1 Each bidder shall furnish, as part of the bid, a bid security in the amount stipulated in the bidding data in Pak Rupees or an equivalent amount in a freely convertible currency.

15.2 The bid security shall be at the option of the bidder, in the form of deposit at call, Pay order or a bank guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favour of the procuring agency, which should commensurate with the bid validity period. The bank guarantee for bid security shall be acceptable in the manner as provided at Annexure BS-1.

15.3 Any bid not accompanied by an acceptable bid security shall be rejected by the procuring agency as non-responsive.

15.4 Bid security shall be released to the unsuccessful bidders once the contract has been signed with the successful bidder or the validity period has expired.

15.5 The bid security of the successful bidder shall be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

15.6 The bid security may be forfeited:

(a) If the bidder withdraws his bid except as provided in sub- clause IB 22.1;

(b) if the bidder does not accept the correction of his bid price pursuant to sub- clause IB 27.2 hereof; or

(c) In the case of successful bidder, if he fails within the specified time limit to:

(i) Furnish the required Performance Security; or

(ii) Sign the Contract Agreement, or

IB.16 Alternate Proposals/Bids

16.1 Each bidder shall submit only one bid either by himself, or as a member of a joint venture, until and unless they have been requested or permitted for alternative bid, then he has to purchase separate bidding documents and alternate bid shall be treated as separate bid.

16.2 Alternate proposals are allowed only for procurement of works where technical complexity is involved and more than one designs or technical solutions are being offered. Two stage two envelope bidding procedure will be appropriate when alternate proposal is required.

16.3 Alternate bid(s) shall contain (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided that the total sum entered on the Form of Bid shall be that which represents complete compliance with the bidding documents.

IB.17 Pre-Bid Meeting

17.1 Procuring agency may, on his own motion or at the request of any bidder, hold a pre-bid meeting to clarify issues and to answer any questions on matters related to the bidding documents. The date, time and venue of pre-bid meeting, if convened, shall be communicated to all bidders. All bidders or their authorized representatives shall be invited to attend such a pre-bid meeting at their own expense.

17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Procuring agency not later than seven (7) days before the proposed pre-bid meeting.

17.3 Minutes of the pre-bid meeting, including the text of the questions raised and the replies given, will be transmitted without delay to all bidders. Any modification of the bidding documents listed in sub- clause IB 7.1 hereof, which may become necessary as a result of the pre-bid meeting shall be made by the procuring agency exclusively through the issue of an Addendum pursuant to Clause IB.9 and not through the minutes of the pre-bid meeting.

17.4 Absence at the pre-bid meeting will not be a cause for disqualification of a bidder.

IB.18 Format and Signing of Bid

18.1 Bidders are particularly directed that the amount entered on the Form of Bid shall be for performing the contract strictly in accordance with the bidding documents.

18.2 All appendices to bid are to be properly completed and signed.

18.3 Alteration is not to be made neither in the Form of Bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.

18.4 Each bidder shall prepare by filling out the forms without alterations and shall provide an original copy along with photocopies as per the requirement of the Procuring Agency specified in the bidding data. The original as well as copies of the document shall be clearly marked as “ORIGINAL” and “COPY”, as the case

may be. If there is any discrepancy between original and copy (ies) then the original shall prevail.

18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person(s) duly authorized to sign on behalf of the bidder pursuant to sub- clause IB 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person(s) signing the bid.

18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the procuring agency, or as are necessary to correct errors made by the bidder. Such corrections shall be initialed by the person(s) signing the bid.

18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper postal addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the contract is to be sent.

18.8 Bidders should retain a copy of the bidding documents as their file copy.

D. SUBMISSION OF BIDS

IB.19 Sealing and Marking of Bids

19.1 Each bidder shall submit his bid as under:

(a) ORIGINAL and each COPY of the bid shall be separately sealed and put in separate envelopes and marked as such.

(b) The envelopes containing the ORIGINAL and COPIES shall be put in one sealed envelope and addressed as given in sub – clause IB 19.2 hereof.

19.2 The inner and outer envelopes shall:

(a) be addressed to the procuring agency at the address provided in the bidding data;
(b) bear the name and identification number of the contract as defined in the bidding data; and
(c) provide a warning not to open before the time and date for bid opening, as specified in the bidding data.

19.3 In addition to the identification required in sub- clause IB 19.2 hereof, the inner envelope shall indicate the name and postal address of the bidder to enable the bid to be returned unopened in case it is declared “late” pursuant to Clause IB.21.

19.4 If the outer envelope is not sealed and marked as above, the procuring agency will assume no responsibility for the misplacement or premature opening of the Bid.

IB.20 Deadline for Submission of Bids

20.1

(a) Bids must be received by the procuring agency at the address specified not later than the time and date stipulated in the bidding data,

(b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of bids. No claims shall be entertained for refund of such expenses.

(c) Where delivery of a bid is by mail and the bidder wishes to receive an acknowledgment of receipt of such bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed bid package,

(d) Upon request, acknowledgment of receipt of bids will be provided to those making delivery in person or by messenger.

20.2 The Procuring Agency may, at its discretion, extend the deadline for submission of bids by issuing an amendment in accordance with IB-9. In such case, all rights and obligations of the procuring agency and the bidders shall remain the same as mentioned in the original deadline.

IB.21 Late Bids

(a) Any bid received by the procuring agency after the deadline for submission of bids prescribed in to clause IB 20 shall be returned unopened to such bidder.

(b) Delays in the mail, person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder's responsibility to submit the bid in time.

IB.22 Modification, Substitution and Withdrawal of Bids

22.1 Any bidder may modify, substitute or withdraw his bid after bid submission provided that the modification, substitution or written notice of withdrawal is received by the procuring agency prior to the deadline for submission of bids.

22.2 The modification, substitution, or notice for withdrawal of any bid shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause IB.19 with the outer and inner envelopes additionally marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" as appropriate.

22.3 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with to sub - clauses IB22.1 and IB 27.2.

22.4 Withdrawal of a bid during the interval between the deadlines for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the bid security in pursuance to clause IB 15.

E. BID OPENING AND EVALUATION

IB.23 Bid Opening

23.1 Procuring Agency will open the bids, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders' representatives who choose to attend, at the time, date and location stipulated in the bidding data. The bidders or their representatives who are in attendance shall sign an attendance sheet.

23.2 Envelopes marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to clause IB.22 shall not be opened.

23.3 Procuring Agency shall read aloud the name of the bidder, total bid price and price of any Alternate Proposal(s), if any, discounts, bid modifications, substitution and withdrawals, the presence or absence of bid security, and such other details as the Procuring Agency may consider appropriate, and total amount of each bid, and of any alternative bids if they have been requested or permitted, shall be read aloud and recorded when opened.

23.4 Procuring Agency shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the sub-clause IB.23.3.

IB.24 Process to be Confidential (SPP Rule 53)

24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of bid evaluation report in accordance with the requirements of Rule 45, which states that Procuring agencies shall announce the results of bid evaluation in the form of a report giving reasons for acceptance or rejection of bids. The report shall be hoisted on website of authority and that of procuring agency if it website exists and intimated to all bidders at least seven (7) days prior to the award of contract The announcement to all bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the procuring agency's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas, any bidder

feeling aggrieved, may lodge a written complaint as per Rule 31; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bid (SPP Rule 43)

25.1 To assist in the examination, evaluation and comparison of bids, the procuring agency may, at its discretion, ask any bidder for clarification of the bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the procuring agency in the evaluation of the bids in accordance with Clause IB. 28.

IB.26 Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the procuring agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in the tender notice such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding document. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.

26.2 Once found to be fulfilling the eligibility criteria, as mentioned in sub- clause 26.1, the bids of eligible bidders will be evaluated for technical responsiveness as per specifications and criteria given in the bidding documents. Technical and financial evaluations may be carried out in accordance with single stage-single envelope, single stage-two envelopes, two stage or two stage-two envelopes bidding procedures, depending on the selection procedure adopted by the Procuring Agency.

26.3 A bid will be considered responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) conforms to all the terms, conditions and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the procuring agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.4 If a bid has major deviations to the commercial requirements and technical specifications will be considered technically non responsive. As a general rule, major deviations are those that if accepted, would not fulfill the purposes for which the bid is requested, or would prevent a fair comparison or affect the ranking of the bids that are compliant with the bidding documents.

(A) Major (material) Deviations include:

i. has been not properly signed;
ii. is not accompanied by the bid security of required amount and manner;
iii. stipulating price adjustment when fixed price bids were called for;
iv. failing to respond to specifications;
v. failing to comply with Mile-stones/Critical dates provided in Bidding Documents;
vi. sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;
vii. refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;
viii. taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;
ix. a material deviation or reservation is one :

(a) which affect in any substantial way the scope, quality or performance of the works;

(b) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

(B) Minor Deviations

Bids that offer deviations acceptable to the Procuring Agency and which can be assigned a monetary value may be considered substantially responsive at least as to the issue of fairness. This value would however be added as an adjustment for evaluation purposes only during the detailed evaluation process.

26.5 If a bid is not substantially responsive, it will be rejected by the procuring agency, and may not subsequently be made responsive by correction or withdrawal of the non- conforming deviation or reservation.

IB.27 Correction of Errors before Financial Evaluation

27.1 Bids determined to be substantially responsive will be checked by the procuring agency for any arithmetic errors. Errors will be corrected by the procuring agency as follows:

(a) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and

(b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the procuring agency there is an obviously gross misplacement of the decimal point in the unit rate, in

which case the line item total as quoted will govern and the unit rate will be corrected.

27.2 The amount stated in the Form of Bid will be adjusted by the procuring agency in accordance with the above procedure for the correction of errors and with the concurrence of the bidders. The amount thus corrected shall be considered as binding upon the bidder. If the bidder does not accept the corrected bid price, his bid will be rejected, and the bid security shall be forfeited in accordance with sub-clause IB 15.6(b) hereof.

IB.28 Financial Evaluation and Comparison of Bids

28.1 The procuring agency will evaluate and compare only the Bids determined to be substantially responsive in accordance with clause IB 26.

28.2 In evaluating the Bids, the procuring agency will determine for each bid the evaluated bid price by adjusting the bid price as follows:

(a) making any correction for errors pursuant to clause IB 27;

(b) excluding provisional sums (if any), for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and

(c) making an appropriate adjustment for any other acceptable variation or deviation.

28.3 The estimated effect of the price adjustment provisions of the conditions of contract, applied over the period of execution of the contract, shall not be taken into account in bid evaluation.

28.4 If the bid of the successful bidder is seriously unbalanced in relation to the procuring agency's estimate of the cost of work to be performed under the contract, the procuring agency may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the procuring agency may require that the amount of the Performance Security set forth in clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the procuring agency against financial loss in the event of default of the successful bidder under the contract.

28.5 Bidders may be excluded if involved in "Corrupt and Fraudulent Practices" means either one or any combination of the practices given below SPP Rule2 (q);

(i) "**Coercive Practice**" means any impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence the actions of a party to achieve a wrongful gain or to cause a wrongful loss to another party;

(ii) "**Collusive Practice"** means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the Procuring Agency to establish prices at artificial, non-competitive levels for any wrongful gain;

(iii) "**Corrupt Practice**" means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain;

(iv) "**Fraudulent Practice**" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(v) "**Obstructive Practice**" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially

impede the exercise of inspection and audit rights provided for under the Rules.

28.6 Evaluation Report (SPP Rule 45)

After the completion of evaluation process, as described in clauses IB 27 and IB 28, the Procuring Agency shall announce the results of bid evaluation in the form of report (available on the website of the authority) giving reasons for acceptance and rejection of bid. The report shall be hoisted on website of the authority and that of Procuring Agency if its website exists and intimated to all bidders at least seven (7) days prior to the award of contract.

F. AWARD OF CONTRACT

IB.29 Award (SPP Rule 49)

29.1 Subject to clauses IB 30 and IB 34 and provision of the rule: The procuring agency shall award the contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents, and who has offered the lowest evaluated bid, but not necessarily the lowest submitted price, within the original or extended period of bid validity. Provided that such bidder has been determined to be eligible in accordance with the provisions of clause IB.3 and qualify pursuant to sub- clause IB 29.2.

29.2 Procuring agency, at any stage of the bid evaluation, having credible reasons for or having prima facie evidence of any deficiency(ies) in contractor's capacities, may require the contractor to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not for the said project.

Provided, that such qualification shall only be laid down after recording reasons thereof, in writing. They shall form part of the records of that bid evaluation report.

IB.30 Procuring Agency's Right to reject all Bids or Annul/Cancellation the Bidding Process (SPP- Rules 25)

Notwithstanding clause IB. 29 and provision of the rule: (1) A procuring agency reserves may cancel the bidding process at any time prior to the acceptance of a bid or proposal; (2) The procuring agency shall incur no liability towards bidders solely by virtue of its invoking sub –rule (1); (3) Intimation of the cancellation of bidding process shall be given promptly to all bidders and bid security shall be returned along with such intimation; (4) The procuring agency shall, upon request by any of the bidders, communicate to such bidder, grounds for cancellation of the bidding process, but is not required to justify such grounds.

IB.31 Notification/Publication of the Award of Contract (SPP Rule 25).

31.1 Prior to expiry of the period of bid validity, including extension, prescribed by the procuring agency, the procuring agency shall notify the successful bidder in writing ("Letter of Acceptance") that his bid has been accepted. This letter shall mention the sum which the procuring agency will pay to the contractor in consideration of the execution and completion of the works by the contractor as prescribed by the contract (hereinafter and in the conditions of contract called the "Contract Price").

31.2 No negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, procuring agency may hold meetings to clarify any item in the bid evaluation report.

31.3 The notification of award and its acceptance by the bidder will constitute the formation of the contract, binding the procuring agency and the bidder till signing of the formal Contract Agreement.

31.4 Upon furnishing by the successful bidder of a Performance Security and signing of the contract, the procuring agency will promptly notify the name of the successful bidder to all bidders and return their bid securities accordingly.

31.5 Within seven days of the award of contract, procuring agency shall publish on the website of the Authority and on its own website, if such a website exists, the

results of the bidding process, identify the bid through procurement identifying numbers, and the following information:

(1) Evaluation Reports
(2) Form of Contract and Letter of Award
(3) Bill of Quantities or Schedule of Requirements

31.6 Debriefing (SPP Rule 51).

(a) A bidder may ask the procuring agency for reasons for non-acceptance of his bid and may request for a debriefing meeting and procuring agency shall give him the reasons for such non acceptance, either in writing or by holding a debriefing meeting with such a bidder.

(b) The requesting bidder shall bear all the costs of attending such a debriefing.

IB.32 Performance Security (SPP Rule 39)

32.1 The successful bidder shall furnish to the procuring agency a Performance Security in the form of pay order or demand draft or bank guarantee, and the amount stipulated in the bidding data and the Conditions of Contract within a period of 28 days after the receipt of Letter of Acceptance.

32.2 Failure of the successful bidder to comply with the requirements of Sub-clause IB.32.1 or clauses IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

32.3 Validity of performance security shall extend at least ninety days beyond the date of completion of contract, or as mentioned in the bidding data to cover defects liability period or maintenance period subject to final acceptance by the procuring agency.

IB.33 Signing of Contract Agreement (SPP Rule 39)

33.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the procuring agency will send the successful bidder the Contract Agreement in the form provided in the bidding documents, incorporating all agreements between the parties.

33.2 The formal Agreement between the procuring agency and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the procuring agency.

33.3 A procurement contract shall come into force when the procuring agency requires signs contract, the date on which the signatures of both the procuring agency and the successful bidder are affixed to the written contract. Such affixing of signatures shall take place within the time prescribed in the bidding documents.

Provided that the procuring agency may reduce the maximum time limit for signing of contract, as and when required, and shall be mentioned in the bidding documents.

33.4 Stamp Duty.

The formal Agreement between the Procuring Agency and the successful bidder shall be duly stamped at the rate enforced at the time of signing of the Contract Agreement as stated in the Letter of Acceptance as a percentage of bid price (updated from time to time), and shall be paid by the successful bidder

IB.34 General Performance of the Bidders

Procuring agency may in case of consistent poor performance of the contractor and his failure to remedy the underperforming contract may take such action as may be deemed appropriate under the circumstances of the case including the rescinding the contract and/or black listing of such contractor and debarring him from participation in future bidding process.

IB.35 Integrity Pact (SPP Rule 89)

The bidder shall sign and stamp the Integrity Pact provided at Appendix-M to the bidding documents for all Provincial/Local Government procurement contracts exceeding Rupees ten million. Failure to provide such Integrity Pact shall make the bidder non-responsive.

IB.36 Instructions not Part of Contract

Bids shall be prepared and submitted in accordance with these Instructions which are provided to assist bidders in preparing their bids, and do not constitute part of the bid or the Contract Documents.

IB.37 Arbitration (SPP Rule 34)

Any dispute that is not amicably resolved shall be finally settled, unless otherwise specified in the Contract, under the Arbitration Act 1940 updated from time to time and would be held anywhere in the Province of Sindh at the discretion of procuring agency.

BIDDING DATA

BIDDING DATA

The following specific data for the works to be tendered shall complement, amend, or supplement the provisions in the Instructions to Bidders. Wherever there is a conflict, the provisions herein shall prevail over those in the Instructions to Bidders.

Reference to Instructions to Bidders	Bidding Data
IB-1 **1.1**	**Scope of Bid** The Work under this Contract is part of the Waste Water, Water Supply and Allied Works of Municipal Services Delivery Program (MSDP) for Improvement of Jacobabad Water, Wastewater and Solid Waste Infrastructure and is described as below: **CONTRACT PACKAGE, AWW-01** **REHABILITATION/STRENGTHENING OF OXIDATION PONDS (ZONE A, B & D) AT JACOBABAD.**
1.1a	**Name and Address of Procuring Agency**: The Program Management Unit (PMU) USAID-Sindh MSDP D-18,Block-2, Kehkashan, Clifton Karachi Tel : 021-35810017-18
IB-2	**Source of Funds**
2.1	The procurement of all construction services for water, wastewater, and solid waste infrastructure in Jacobabad City will be the responsibility of the Program Management Unit (PMU) which has been established by Government of Sindh (GoS) whereas the USAID is providing a grant in aid to the Government of Pakistan along with Government of Sindh shared as part for these services. Through the use of Cost Reimbursement Agreements, USAID will reimburse the Government of Sindh for the cost of their agreed part of these projects. The part of the funds will be used towards the cost of this project and to cover eligible payments under the Contract for the Works.
IB-3	**Eligible Bidders**
3.1	**Delete the text of sub-clause 3.1 in its entirety and substitute with the following;** This invitation for Bids is open to all eligible bidders, as specified in Notice Inviting Tender.
IB-6	**Site Visits**
6.1	**Delete the text of sub-clause 6.1 and substitute with the following;** The Bidder or his authorized representative shall visit and inspect the Site of Works including suitable areas in the vicinity and surroundings to be used for Contractor's Camp, on his own responsibility and at his own expense, and obtain all the required information from his own sources which may be necessary for the purpose of preparing the Bid. The Procuring Agency may assist but will not take any responsibility for the supply or correctness of the information.

	The Bidder shall, before submitting his Bid, satisfy himself in all respects including but not limited to the following: a. The existing facilities in the vicinity of the Site of Work, the hydrological, climatological and sub-surface conditions, the form and nature of the Site of Work. b. The quantities and nature of the work and availability of materials necessary for the completion of the Works. c. The means of access to the site of work and exit from the site. d. The availability of space for Contractor's Camp Facilities within or outside the site of work. e. All necessary information as to risks, contingencies and other circumstances, which may influence or affect the Bid. f. The type and nature of soil existing in area of work. g. The existing physical conditions at Site including any obstructions or restrictions affecting the execution of works. Each Bidder shall also enquire and satisfy himself as to the source, the quantity of supply, the sufficiency of and the means of obtaining and transporting all plant, material, labor, fuel, water, electricity, and other matters or things required for or in connection with the Works. In preparing the Bid, the Bidder shall also consider his obligation to adequately store all materials and maintain existing facilities and all Temporary Works during the period of his usage. The Bidder must make local inquiries as to the physical conditions prevailing at the Site and obtain his own information on all matters and things that may in any way influence him in making a Bid and fixing the rates in the Bill of Quantities. He must also satisfy himself as to the risks, obligations and responsibilities to be undertaken in accordance to the Contract to be entered into by him should his Bid be accepted. The Bidder shall make his own investigations, enquiries and assessments, on all matters, of all conditions of existing constructions at the site and its vicinity, to his satisfaction before submitting his bid. All costs thus incurred on the above accounts shall be at the bidder's own expense.
IB-7	**Contents of Bidding Documents**
7.1	**Delete the text of sub-clause 7.1 and substitute with the following;** The Bidding Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause IB.9: **Volume: I.** **(a)** • Notice Inviting Tender • Instructions to Bidders • Bidding Data, Qualification Criteria & Performas. • Forms

	• Conditions of Contract, Part-I, General Conditions • Conditions of Contract, Part II –Particular Conditions **(b)** • Letter of Technical & financial Bid Price & Appendices including BOQ **Volume-II** • Technical Specifications & Tender Drawings
IB-8	**Time limit for clarification:**
8.1	Time limit for Clarifications as mentioned in the NIT.
IB-10	**Language of Bid**
10.1	The language of Bid is ENGLISH.
IB-11 11.1(b)	**Documents Accompanying the Bid:** Delete this sub-clause 11.1 (b) in its entirety & substitution with the following: The supporting documents to be attached with Volume I(A) to comply the firm against each eligibility & qualification criteria as announced.
IB-12 12.1	**Bid Prices** In line two, “unit” be read as “item”
IB-12.3	**Bid Prices** **Add the following paragraphs to sub-clause 12.3:** (a) The Bidder, by the act of submitting a Bid, acknowledges that he has inspected the Site of Works and determined the general characteristics and conditions. The Procuring Agency will not assume any responsibility for information, interpretations and deductions the Bidder may make from the information furnished by the Procuring Agency or the Engineer. No verbal communication or conversation with any officer, employee or agent of the Procuring Agency or the Engineer before, during or after the execution of the Contract shall effect or modify any of the terms or obligations contained in the Contract. (b) The attention of the Bidder is drawn to the fact that local regulations require special procedures, rules and regulations to be complied with in connection with the ordering, purchasing and importing of materials from outside Pakistan. Bidder will be deemed to have obtained full information about all such matters and to have allowed in his Bid for all delays, additional costs and financial charges that may arise directly or indirectly there from. (c) Any neglect or failure on the part of the Bidder to obtain reliable information on the spot or elsewhere on the foregoing or on any other matters affecting his bid prices and rates, the execution and completion of the Works and the Contract shall not relieve the Bidder whose Bid is accepted from any risks or liabilities or from the responsibility of completing and handing over the Works on contract completion date.
IB-12.5 (Additional)	Add the following sub Clause 12.5 The rates and price submitted by the bidder shall be exclusive of Sales

	Tax. The Contractor will be responsible for obtaining exemption of Sales tax from EAD, however Client will assist the Contractor for the same.
IB-13	**Currencies of Bid and Payment**
13.1	**Delete the text of sub-clause 13.1 and substitute with the following**; The unit rates and the prices shall be quoted by the Bidder entirely in Pak Rupees. A Bidder expecting to incur expenditures in other currencies for performing his obligations under the Contract shall bear all costs and risks for arranging the requirements of such currencies through his own resources.
13.2	Delete the text of sub-clause 13.2.
IB-14	**Bid Validity:**
14.1	Period of Bid Validity is 90 days after the date of Bid opening which can be extended for further Ninety 90 days with mutual consent as per SPPRA Rule 2010 (amended).
14.2	delete in third line “one third of”
IB-15	**Amount of Bid Security:**
15.1	2% of Bid Price, either in the shape of Call Deposit, Demand Draft/Pay Order or Bank Guarantee in favor of “The Program Director, Sindh MSDP”. The Bid Security shall remain valid for a period of twenty eight (28) days beyond the bid validity date. Name of Contract Package and the name of Bidder should be clearly typed on the envelope.
15.2	Replace in fourth line “ Procuring Agency “with “ Program Director MSDP”
IB-16	**Alternate Proposals** **Delete the complete clause IB-16 subclause 16.1, 16.2 & 16.3**
IB-17	**Venue, time, and date of the Pre-Bid meeting.**
	Delete the complete clause of IB-17 under sub-clause 17.1, 17.2, 17.3 & 17.4
IB-18	**Number of copies of the Bids to be completed and returned:**
18.1	Add the following: The amount or any other information reflected in other than form of Bid cannot be accepted.
18.4	One Original + One Copy of Bidding Documents.
18.5	**Signing of Bid:** **Delete the last sentence of this para from “All pages…….. the Bid” and substitute with the following:** All pages of the Bid including appendices, addenda, corrigenda, clarifications, and supplementary information as issued shall be initialed and stamped by the authorized person(s) signing the bid.
18.6	**Correction of Bids** **Add the following at the end of this sub clause:** Each correction shall be separately signed and stamped. Over-writing, erasures, use of whitening fluid, correction tape for making corrections is not permitted. Noncompliance of these instructions may be construed as sufficient ground to render the Bid non-responsive. Client has right to ask the successful bidder to correct unreasonable front loaded/ unbalanced item rates, if any, without altering the total bid cost.
18.7	**Preparation of Bid**

	Add the following at the end of sub-clause 18.7: Bids shall be prepared and submitted on the "Form of the Bid" All blank spaces must be filled in and completed Form must be without interlineations or alterations of the original wording. Bids with incomplete and/or un-signed Form of Bid may be rejected /considered Non Responsive. The Bidder shall stamp and sign each page of Bid Documents for the purpose of identification and acknowledgement of acceptance thereof. The Bids must conform in all respects to the Bidding Documents.
IB-19 19.2(a)& (b)	**Procuring Agency's address for the purpose of bid submission:** Bid comprise all volumes of Contract Documents in single envelopes. Envelope shall be marked with the name of proposal in bold and eligible letters. **Procuring Agency's address for the purpose of Bid submission shall be:** The Program Management Unit (PMU) USAID-Sindh MSDP D-18,Block-2, Kehkashan, Clifton Karachi, Tel : 021-35810017-18 **Name and Identification Number of the Contract:** **CONTRACT PACKAGE, AWW-01** **REHABILITATION/STRENGTHENING OF OXIDATION PONDS (ZONE A, B & D) AT JACOBABAD.**
IB-20	**(a)Deadline for submission of Bids:**
20.1	As notified in the "Invitation for Bid".
IB-23.1	**Add the following:** **"The Technical offer will be evaluated first and subsequently financial offer of technically qualified bidders will be opened for final evaluation" (SPP Rules to be followed considered).**
IB-23.1	**Venue, time, and date of bid opening:** **Venue:** The Program Management Unit (PMU) USAID-Sindh MSDP D-18,Block-2, Kehkashan, Clifton Karachi Tel : 021-35810017-18 **Time:** notified in the "Invitation for Bid". **Date:** notified in the "Invitation for Bid".
IB-26	**Examination of Bids and Determination of Responsiveness**
26.2	Bidding Procedure is National Competitive Bidding with Single Stage Two Envelop method.
26.6	**Add the following additional sub clause IB-26.6** The Bidders not fulfilling / submitting the required data/information given in Appendix A to Bid 1.1 shall be considered as non-responsive & be declared technically non-qualified.
IB-28.6	Replace in last line "Seven (7) days" with "four (04 Working or Calendar) days"
IB-28.7	**Add the following additional sub-clause IB-28.7:**

	Technical Qualification
28.7 (a)	The Procuring Agency will conduct Technical Qualification of all Bidders and Determine whether the Bidder is technically qualified or not.
28.7 (b)	The determination will take into account the Bidder's financial and technical capabilities. It will be based upon an Evaluation criteria of the Bidder's qualification submitted under Appendix - A to Bidding Data "Technical Evaluation Criteria" by the Bidder. Each criteria to be needed by the bidder to declare qualify & consider this financial offer for further evaluation.
28.7 (c)	The procedure of single stage – Single Envelop of SPP Rule 2010 (Update March- 2022) will be followed. The financial offer will be considered of any bidder when qualify for each Eligibility & Qualification Criteria.
IB-29	**Award**
29.1	**Delete the last sentence of this para from " Provided that such bidder…….pursuant to sub-clause IB 29.2" and substitute with the following:** Provided that such bidder has been determined to be qualified to satisfactorily perform the Contract in accordance with the provisions of additional sub-clause IB-28.7.
IB-31.6	Add "within four (04) working days" in first line.
IB-32	**Standard Form and amount of Performance Security acceptable to the Procuring agency:**
32.1	**Delete the text of sub-clause 32.1 and substitute with the following;** The successful bidder shall furnish to the Procuring Agency a Performance Security. The said Security shall be furnished or caused to be furnished by the Bidder within 14 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 5% of the Contract Price stated in the Letter of Acceptance. Such Security shall, at the option of the bidder, be in the form of either (a) unconditional bank guarantee from any Scheduled Bank in Pakistan, or (b) unconditional bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan. The cost of complying with requirements of this Sub-Clause shall be borne by the Bidder.
32.2	The Contractor's failure to furnish the Performance Security within the time stated above shall be considered enough ground for rejection of his bid and forfeiture of his bid security.
32.3	**Delete the text of sub-clause 32.3 and substitute with the following;** The validity of the Performance Security shall extend at least 28 days beyond the date of Defects Liability Period subject to final acceptance by the Procuring Agency through Performance Certificate.
IB-33.1	Replace "14 working days" with "4" in first line.
IB-33.2	Replace "14 working days" with "4" in Second line.
Add the following Clauses 38 – 42	
IB-38	**Sufficiency of Bids**
38.1	Each Bidder shall be deemed to have satisfied himself fully, before submitting the Bid, as to all aspects of the Works, correctness and sufficiency of his Bid and of rates and prices stated in the Bill of Quantities, which rates and prices shall, except in so far as it is otherwise expressly

	provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper completion of the Works. All complaints and objections on tender procurement process will be governed under the available Clauses of SPPRA 2010 (Updated March 2022)
IB- 39	**Substitution of Codes & Standards**
39.1	Codes and Standards other than those referred to in the Specifications may be accepted provided the Engineer is satisfied that the proposed Codes and Standards are equivalent or better than those specified. If any of these alternative Codes and Standards is proposed to be used, it must be clearly stated in the Form of Bid. The general intent of the Specifications must be maintained. The decision of the Engineer as to whether alternative Codes and Standards fulfill the requirements of prescribed Standard and Codes, at all times, shall be final.
IB-40	**Sub-Contractors**
40.1	The successful Bidder will be wholly and solely responsible for completing all the works under the contract. Hiring a Sub-contractor or sub-letting any (or all) part(s) is not allowed in this contract. Overall responsibility of all works shall rest with the Bidder
IB-41	**Insurance**
41.1	The Bidder shall estimate the amounts required to provide the insurance from approved insurers as specified in the Conditions of Contract Part-I & Part-II and the Bid Price shall be deemed to include all such costs and amounts. The successful Bidder shall ensure the work in accordance with Conditions of Contract Part I, Part II and ensure that it has become effective prior to commencement of work on site and is valid as per the requirements of the Contract.
IB-42	**Alterations**
42.1	No alterations and/or additions shall be made in the Form of Bid, Bill of Quantities and the accompanying documents, and if any such alteration / addition is made or if the Bill of Quantities is not properly filled in, or if these instructions are not fully complied with, the Bid will be rejected.

APPENDIX TO BIDDING DATA

ELIGIBILITY CRITERIA

1.1 Bidders meeting all Eligibility Criteria as mentioned below shall be declared as eligible for consideration of their Financial Bid.

(NOTE: The Bidders not fulfilling / submitting any of the below requirements shall be considered as non-responsive and their bids shall be declared as rejected.

i. Properly Sealed Envelope, marked with name of tender and name of bidder.

ii. Attachment of tender cost with the bid, if downloaded from the website.

iii. Attachment of Bid security with the bid as per NIT/ Bidding document.

iv. Bidder should submit Valid Registration Certificate of Pakistan Engineering Council in minimum category as mentioned in NIT with Specialization Codes of CE09, CE10. (In case of JV, all members of JV shall have valid PEC registration but one of them must have registration in minimum then referred category as mentioned in the NIT category).

v. Bidder (lead and all partners of JV) should submit Certificate of Registration with SRB

vi. Bidder (lead and all partners of JV) should submit NTN Certificate

vii. Bidder should submit work orders or completion certificates to prove that the firm has undertaken at least two (02) projects of Sewerage or Water Supply of cumulative value of projects not less than estimated cost.

viii. Bidder (lead and all partners of JV) should submit Auditor's Balance Sheets for the last 03 years 2019-20, 2020-21 & 2021-22 prepared from any registered Chartered Accountant Firm showing that the firm has average annual turnover of last three years equal to 25% of the project estimated cost.

ix. Available Cash in hand and/or through Banking Loan facility equal to 30% amount of the project estimated cost. (Attach Current Bank Statement and/or Proof of Bank Loan Facility Documents)

x. Bidder (lead and all partners of JV) should submit FBR's Tax Returns for last 03 years 2019-20, 2020-21 & 2021-22.

xi. The bid shall be quoted with the branded pipes of manufacturer having ISO Certification and the bidder shall have the authorization letter from the manufacturer of pipes to participant for this specific bid.

xii. "Non-Blacklisting" Declaration on Stamp paper of Rs.500/= duly signed and stamped by the Bidder (lead and all partners of JV). The applicant should never be blacklisted from any Government, Semi-Government, Authorities or Autonomous Bodies etc.

xiii. "No Litigation" Declaration on Stamp Paper of Rs. 500/- duly signed and stamped by the Bidder (lead and all partners of JV). (No bid will be accepted / opened for evaluation if the bidder is found in litigation with any Government, Semi-Government, Authorities or Autonomous Bodies etc at the time of bidding for this work and the case is not finalized by the Honorable Court. In this case the financial bid shall be returned un-opened.)

xiv. Integrity Pact duly filled, on Stamp Paper of Rs. 500/- duly signed and stamped by the Bidder (lead and all partners of JV) in the prescribed format (Refer Appendix-M page 51)

TECHNICAL EVALUATION CRITERIA

1.2 The following weightages as detailed in 3.1 will be used in the Evaluation of the Bids for technical qualification.

(**NOTE: To technically qualify Bidders must obtain not less than the minimum in each category at S. No. 1 to 4, which is mandatory; failing which the Bidder shall be considered technically non-qualified and his financial bid shall be returned un-opened.)**

S.No	Category
1	Qualification of Firms Bidder should submit work orders or completion certificates to prove that the firm has undertaken at least two (02) projects of Sewerage and Construction of Oxidation Ponds of cumulative value of projects not less than estimated cost.
2	Personnel Capabilities
3	Equipment Capabilities
4	Financial Capabilities

2.0 INSTRUCTIONS TO APPLICANT

2.1 Submission of Applications

2.1.1 The name and mailing address of the Bidder Firm shall be clearly marked on the left Hand side of envelop.

2.1.2 The firm must have a permanent office and permanent staff, having registered mail address and an e-mail address and preferably has its own web site & these can be inspected by the client as and when required. Failure to demonstrate the permanency of the established office, may lead to the disqualification of the Bidder.

2.1.3 The Bidders must respond to all questions and provide complete information as advised in this document. Any lapses to provide essential information may result in disqualification of the Bidder.

2.1.4 The Bidders must respond to all questions and provide complete information in a proper sequence and Forms A-1 to A-7 and these forms shall be filled accordingly. Failure to present the information as asked in form A-1 to A-7 in a proper sequence will result in curtailment of weightage points as per Evaluation Criteria (Not Applicable).

2.1.5 The value of work done and other financial figures should preferably be expressed in Pak Rupee with the conversion factor used.

2.2 Qualification Criteria

2.2.1 General

Qualification will be based on the criteria given in succeeding paras regarding the Bidder's relevant experience, personnel and equipment capabilities, and financial position, as demonstrated by the Bidder's responses. Sub-contractor's experience and resources shall not be taken into account in determining the Bidder's compliance with the qualifying criteria. However, Joint Venture experience of similar works & resources shall be considered. Consortium or Association of firms will be considered for similar treatment as in case of Joint Venture.

2.2.2 Relevant Experience

The Bidder shall meet the following minimum criteria:-
Successful experience as lead contractor in the execution of at least two projects of similar nature and complexity comparable to the proposed contract (s) within the last (05) years. This experience should involve minimum 02 similar activities from the list given in Performa P-2.

2.2.3 Personnel Capabilities

The Bidder must have in his employment suitably qualified personnel for last 12 months as regular employees to fill the following key management and specialist positions. The Bidder must submit the CVs of the below listed staff.

Sr. No.	Position	Minimum Qualifications	Minimum Experience (Years)
1.	Project Engineer (Civil)	Graduate Professional Engineer	10
2.	Site Supervisor - (Civil)	Diploma of Associate Engineer/ Certificate Course	05
3.	Surveyor	Diploma of Associate Engineer/ Certificate Course	05

2.2.4 Equipment Capabilities

The Bidder should own, or have assured access to (through rented, lease, purchase agreement or other means), the following key items of equipment (limited to only major items of equipment) in full working order, and must demonstrate that, based on known commitments, these will be available for deployment on the proposed contract or works. The Bidder must provide lists with details of (1) equipment owned and (2) Equipment hired.

Sr. No	Equipment Type & Characteristics	Minimum Number Required
1	Excavators	**03**
2	Water Bowzer	**03**
3	Tractors Trolley	**03**
4	Concrete Mixer	**03**

2.2.5 Financial Position

The Bidder should demonstrate that he has access to, or has available liquid assets, un-encumbered real assets, lines of credit and other financial means

sufficient to meet the construction cash flow for the execution of works. Bidder's commitments for other ongoing contracts shall also be considered.
The audited balance sheets for the last three years should demonstrate the soundness of the Bidders' financial position, showing long term profitability and should submit unconditional Bank Letter confirming the current available credit line. Where necessary the Employer may make enquiries with the Bidder's Auditors.

2.3 Joint Venture

2.3.1 Joint Venture must comply with the following requirements:-

a) Following are minimum qualification requirements:-

i) The lead partner shall meet not less than 60 percent of the qualifying criteria in Similar nature projects given in the para 1.2.

ii) The joint venture must collectively satisfy the criteria of paras 1.2, for which purpose the relevant figures for each of the partner shall be added together to arrive at the JV's total capacity. The weightage points shall be given on the basis of this total capacity.

b) Bid shall be signed by all members of the JV so as to legally bind all partners, jointly and severally, and the bid shall be submitted with a draft copy of the JV agreement providing joint and several liability with respect to the contract.

c) M.O.U of JV/Consortia made must be signed by all the partners and shall be attached in original.

d) The Bidder (including all members of a JV) must not be associated, nor have been associated in the Past, with the consultant or any other entity that has prepared the design, specifications, and other qualification and bidding documents for the project, or was proposed as Engineer for the contract, over the last five years. Any such association may result in disqualification of the Bidder and JV.

3.1 Detailed Evaluation Criteria

3.1.1 Qualification of Firm

3.1.1		Weightage Points
i	Successful completion of 2 projects of similar nature executed during last 5 years.	

Note:

1. **The Similar Nature Projects shall involve any 02 activities as described in the attached P-2.**

2. **Proof of assignments shall be subject to submission of completion certificate which shall be treated as mandatory requirement, failing which the project shall not be considered for evaluation.**

   In case of unsatisfactory performance a penalty of 10 weightage points shall be imposed on the obtained weightage points against the qualification of firm (Point 3.1.1)

   The details of projects to be furnished on Form A-3 attached.

3.1.2 Personnel Capabilities

Maximum Points

Sr. No.	Position	Minimum Qualifications	Minimum Experience (Years)	Weightage Points
1	Project Engineer (Civil)	Graduate Professional Engineer	**10**	
2	Site Supervisor - (Civil & E&M)	Diploma of Associate Engineer/ Certificate Course	**05**	
3	Surveyor	Diploma of Associate Engineer/ Certificate Course	**05**	
			Total Weightage Points	

Detail CVs to be furnished on Form A-5, attached.

3. 1.3 Equipment Capabilities **Maximum Points**

Sr. No	Equipment Type & Characteristics	Minimum Number Required	Points on Owner ship	Point on Hiring
1	Excavators	2		
2	Water Bowzer	1		
3	Tractors Trolley	3		
4	Concrete Mixer	1		
	Total Weightage Points			

Note:

The Bidder must provide the list of:

(a) Equipment owned by the Bidder along with the ownership documents, if the ownership documents are not provided the equipment shall be considered as hired / rental.

(b) Bidder to furnish detail of equipment on Form A-4 attached.

Not Applicable

3.1.4	Financial Capacity	Maximum Points
1.	**Audited Account Statements for Three years 2019-20, 2020-21 & 2021-22.**	**Weightage Points**
a.	Submit Audit Statements of Three years as mentioned having average annual turnover of last three years equal to 25% of the project estimated cost	
b.	For every 5% exceeding 25% turnover 03 point shall be awarded up to maximum of 15 points	
2.	**Available Cash in hand and/or through Bank Credit facility (Attach Current Bank Statement and/or Proof of Bank Credit Facility Documents)**	**Weightage Points**
	Cash in hand including Bank Credit Facility	
a.	10% amount of project estimated cost	
b.	For every 5% exceeding 10% cash/credit 03 point shall be awarded up to maximum of 15 points	

Note: The Bidder must submit in original the Bank Letter (as per Performa P-1, attached) clearly mentioning the currently available credit line of the Bidder. Attach Current Month Bank Statement of Firm showing available cash. Attach Auditor's balance Sheets for the years **2019-20, 2020-21 & 2021-22.**. Where ever necessary the Employer may make enquiries from the Bidder's Bank and/or Auditors.

Form A-1

General Information

All individual firms and each partner of a joint venture are requested to complete the information in this form. Nationality information is also to be provided for foreign owners or Bidders who are forming part of the Joint Ventures as required under the PEC Bye-Laws as a Partnership/Joint Venture.

Where the Bidder proposes to use named subcontractors for critical components of the works, or for work contents in excess of 10 percent of the value of the whole works, the following information should also be supplied for the specialist subcontractor(s).

1.	Name of Firm	
2.	Head Office Address	
3.	Telephone	Contact Person: Name: Title:
4.	Fax	Telex
5.	Place of Incorporation/Registration	Year of incorporation/registration

NATIONALITY OF OWNERS		
NAME		***NATIONALITY***
1.		
2.		
3.		
4.		
5.		

FormA-2

Joint Venture Summary

Names of all Partners of a Joint Venture
1. Lead Partner
2. Partner
3. Partner
4. Partner
5. Partner
6. Partner

Form A-3

Details of Contracts of Similar Nature and Complexity

Name of Bidder or partner of a joint venture

Use a separate sheet for each contract.

1.	Name of Contract
	Country
2.	Name of Employer
3.	Employer Address ……
4.	Nature of works: …… ……
5.	Contract Role (Tick One) (a) Sole Contractor (b) Sub- Contractor (c) Partner in a Joint Venture
6.	Value of the total contract (in specified currencies) at completion, or at date of award for current contract Currency……. Currency…… Currency……
7.	Equivalent in Pak/Rs.
8.	Date of Award
9.	Date of Completion
10.	Contract Duration (Years and Months) _____Years _____Months
11.	Specified Requirements

Form A-4

Personnel Capabilities

Name of Bidder

For specific positions essential to contract implementation, Bidders should provide the name of candidate qualified to meet the specified requirements stated for each position. The data on their experience should be supplied on separate sheets using one Form for each candidate (Form A-5).

1.	Title of Position
	Name of Prime Candidate
2.	Title of Position
	Name of Prime Candidate
3.	Title of Position
	Name of Candidate
4.	Title of Position
	Name of Prime Candidate
5.	Title of Position
	Name of Candidate

Form A-5

Candidate Summary

Name of Bidder

Position		
Candidate information	1. Name of Candidate	2. Date of Birth
	6. Professional Qualification	
Present employment	4. Name of employer	
	Address of employer	
	Telephone	Contact (manager/personnel officer)
	Fax	Telex
	Job title of candidate	Years with present employer

Summarize professional experience over the last 20 years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the Project.

Month/ Dates/Years		**Company / Project / Position / Relevant technical and management experience**
From	**To**	

Form A-6

Equipment Capabilities

Name of Bidder

The Bidder shall provide adequate information to demonstrate clearly that he has the capability to meet the requirements for each and all items of equipment listed in the Instructions to Bidders. A separate Form shall be prepared for each item of equipment listed in 3.1.3.

Item of Equipment		
Equipment information	1. Name of manufacturer	2. Model and power rating
	3. Capacity	4. Year of manufacture
Current status	5. Current location	
	6. Details of current commitments	
Source	6. Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased	

Omit the following information if it is owned by the Bidder or partner.

Owner	8. Name of owner	
	9. Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreement	Details of rental/lease specific to the Project.	

Form A-7

Financial Capability

Name of Bidder or Partner of a Joint Venture

Bidders, including each partner of a joint venture, should provide financial information to demonstrate that they meet the requirements stated in the Instructions to Bidders. Each Bidder or partner of a joint venture must fill-in this form. If necessary, use separate sheets to provide complete banker information. A copy of the audited balance sheets should be attached.

Banker	Name of banker	
	Address of banker	
	Telephone	Contact name and title
	Fax	Telex

Summarize actual assets and liabilities in Pak Rupees (Equivalent at the current rate of exchange at the end of each year) for the years mentioned in table below.

Financial information in Pak Rs. Or equivalent	**Actual: previous three year**		
	1 (2018-19)	***2 (2017-18)***	***3 (2016-17)***
1. Total assets			
2. Current assets			
3. Total liabilities			
4. Current liabilities			
5. Profits before taxes			
6. Profits after taxes			
7. Turn Over			

Performa P-1

Ref No. ----------
Date: ----------

ON THE LETTER HEAD OF THE BANK

TO WHOM IT MAY CONCERN

*This is to certify that M/s. (**Name, Address of the Company**) are maintaining their Account No. --*

---------- with us satisfactorily.

This is also certified that the above referred company has an approved current credit line facility of Rs. ---------- (Rs. In Words ----------) on the basis of their Financial Strength, Market Reputation and Securities with us. We are confident that they are financially capable to complete any mega project like yours in Pakistan.

*This Certificate is being issued at the request of M/s. (**Name of Company**).*

Authorized Signature ***Authorized Signature***

Description of "Similar Nature Projects"

S.No	***Description of Experience of Similar Nature Projects***
1	Bidder should submit work orders or completion certificates to prove that the firm has undertaken at least two (02) projects of Sewerage or Water supply of cumulative value of projects not less than estimated cost.

Note:

Proof of having completed or in hand any of above minimum two projects shall be considered as having experience of similar nature.

Performa P-3

LETTER OF AVAILABLE CREDIT LINE THROUGH BANK

Reference No. ----------
Date: ----------

ON THE LETTER HEAD OF THE BANK

TO WHOM IT MAY CONCERN

This is to certify that M/s. (**Name, Address of the Company**)are maintaining their Account No. ---------- with us satisfactorily.

This is also certified that the above referred company have an approved current credit line facility of Rs. ---------- (Rs. In Words ----------) on the basis of their Financial Strength, Market Reputation and Securities with us. We are confident that they are financially capable to complete any mega project in Pakistan.

This Certificate is being issued at the request of M/s. (**Name of Company**).

Authorized Signature **Authorized Signature**

Appendix-M to Bid

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC; PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE TO BE SUBMITTED WITH TECHNICAL BID REPRODUCED ON COMPANY LETTER HEAD DULY FILLED & SIGNED)

Contract No. AWW-01 Dated

Contract Value: Not required (Single Stage Single Envelope Procedure).

Contract Title: **REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS (Zone A, B & D) (CONTRACT PACKAGE AWW-01) AT JACOBABAD.**

…… [name of Contractor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Sindh (GoS) or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoS) through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from, from Procuring Agency (PA) except that which has been expressly declared pursuant hereto.

[name of Contractor] accepts full responsibility and strict liability that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Contractor] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other rights and remedies available to PA under any law, contract or other instrument, be voidable at the option of PA.

Notwithstanding any rights and remedies exercised by PA in this regard, [name of Supplier/Contractor/Consultant] agrees to indemnify PA for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to PA in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from PA.

[Procuring Agency]

[Contractor]
Sign & Stamp

FORMS

BID SECURITY PERFORMANCE SECURITY
CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE
INDENTURE BOND FOR SECURED ADVANCE

BID SECURITY
(Bank Guarantee)
(IB-15)

Security Executed on (Date)
Name of Surety (Bank) with Address:

(Scheduled Bank in Pakistan)

Name of Principal (Bidder) with Address

Penal Sum of Security Rupees. _____(Rs. _____)
Bid Reference No. KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto _____ (hereinafter called the 'Procuring Agency') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Bidder has submitted the accompanying bid dated_____for Bid No. _____for_____ (Particulars of Bid) to the said Procuring Agency; and

WHEREAS, the Procuring Agency has required as a condition for considering said bid that the **bidder** furnishes a bid security in the above said sum from a Scheduled Bank in Pakistan or from a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan, to the procuring agency, conditioned as under:

(1) that the bid security shall remain in force up to and including the date 28 days after the deadline for validity of bids as stated in the Instructions to bidders or as it may be extended by the procuring agency, notice of which extension(s) to the Surety is hereby waived;
(2) that the bid security of unsuccessful bidders will be returned by the procuring agency after expiry of its validity or upon signing of the Contract Agreement; and

(3) that in the event of failure of the successful bidder to execute the proposed Contract Agreement for such work and furnish the required Performance Security, the entire said sum be paid immediately to the said Procuring Agency pursuant to Clause 15.6 of the Instruction to bidders for the successful bidder's failure to perform.

NOW THEREFORE, if the successful bidder shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract with the said procuring agency in accordance with his bid as accepted and furnish within (07) days of his being requested to do so, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said procuring agency for the faithful performance and proper fulfillment of the said Contract or in the event of non-withdrawal of the said bid within the time specified for its validity then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

PROVIDED THAT the Surety shall forthwith pay the Procuring Agency, the said sum upon first written demand of the Procuring Agency (without cavil or argument) and without requiring the Procuring Agency to prove or to show grounds or reasons for such demand, notice of which shall be sent by the Procuring Agency by registered post duly addressed to the Surety at its address given above.

PROVIDED ALSO THAT the Procuring Agency shall be the sole and final judge for deciding whether the Principal (Bidder) has duly performed his obligations to sign the Contract Agreement and to furnish the requisite Performance Security within the time stated above, or has defaulted in fulfilling said requirements and the Surety shall pay without objection the said sum upon demand from the Procuring Agency forthwith and without any reference to the Principal (Bidder) or any other person. IN WITNESS WHEREOF, the above bounden Surety has executed the instrument under its seal on the date indicated above, the name and seal of the Surety being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

WITNESS: Signature_____

1. _____ Name _____

_____ Title _____

2. _____

_____

FORM OF PERFORMANCE SECURITY
(Bank Guarantee)
(IB-32)

Guarantee No._____
Executed on_____
Expiry date_____

[Letter by the Guarantor to the Procuring Agency]

Name of Guarantor (Bank) with address:_____
(Scheduled Bank in Pakistan)

Name of Principal (Contractor) with address:_____
_____

Penal Sum of Security (express in words and figures)_____
_____

Letter of Acceptance No._____Dated _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the bidding documents and above said Letter of Acceptance (hereinafter called the Documents) and at the request of the said Principal we, the Guarantor above named, are held and firmly bound unto the
_____ (hereinafter called the Procuring Agency) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Procuring Agency, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has accepted the Employer's above said Letter of Acceptance for_____ (Name of Contract) for the_____(Name of Project).

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Procuring Agency, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the Contract and of any and all modifications of said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till all requirements of Clause 11, Defects Liability, of Conditions of Contract are fulfilled.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, _____(the Guarantor), waiving all objections and defenses under the Contract, do hereby irrevocably and independently guarantee to pay to the Procuring Agency without delay upon the Procuring Agency's first written demand without cavil or arguments and without requiring the Procuring Agency to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Procuring Agency's written declaration that the Principal has refused or failed to perform the obligations under the Contract which Payment will be effected by the Guarantor to Procuring Agency's designated Bank & Account Number.

PROVIDED ALSO THAT the Procuring Agency shall be the sole and final judge for deciding whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling said obligations and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the Procuring Agency forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above-bounden Guarantor has executed this Instrument under its seal on the date indicated above, the name and corporate seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____
Guarantor (Bank)

Witness:

1. _____ Signature _____

_____ Name_____
Corporate Secretary (Seal)

Title _____

2. _____

_____

_____ _____
Name, Title & Address Corporate Guarantor (Seal)

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of _____ (month), 20 between _____ (hereafter called the " Procuring Agency") of the one part and _____ (hereafter called the "Contractor") of the other part.

WHEREAS the Procuring Agency is desirous that certain works, viz. _____ should be executed by the Contractor and has accepted a bid by the Contractor for a Contract Sum of _____ for the execution and completion of such works and the remedying of any defects therein.

NOW this Agreement witnesseth as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents after incorporating addenda, if any, except those parts relating to Instructions to bidders shall be deemed to form and be read and construed as part of this Agreement, viz.:

   (a) The Contract Agreement;
   (b) The Letter of Acceptance;
   (c) The completed Form of Bid;
   (d) Special Stipulations (Appendix-A to Bid);
   (e) (Part-I : The General Conditions of Contract)
   (f) (Part-II : Special/ The Particular Conditions of Contract).
   (g) The priced Bill of Quantities (Appendix-D to Bid);
   (h) The completed Appendices to Bid (B, C, E to L);
   (i) The Drawings;
   (j) The Specifications.
   (k) EMMP
   (l) _____(any other)

3. In consideration of the payments to be made by the Procuring Agency to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Agency to execute and complete the works and remedy defects therein in conformity and in all respects with the provisions of the contract.

4. Procuring Agency hereby covenants to pay the contractor, in consideration of the execution and completion of the works as per provisions of the contract, the contract Price or such other sum as may become payable under the provisions of the contract at the times and in the manner prescribed by the contract.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed on the day, month and year first before written in accordance with their respective laws.

Signature of the Contactor	Signature of Employer
(Seal)	(Seal)
Signed, Sealed and Delivered in the presence of:	
Witness:	Witness:
(Name, Title and Address)	(Name, Title and Address)

MOBILIZATION ADVANCE GUARANTEE

Bank Guarantee No. _____ Date _____

WHEREAS _____ (hereinafter called the 'Procuring Agency') has entered into a Contract for _____
(Particulars of Contract)
with _____ (hereinafter called the "Contractor").

AND WHEREAS, the Procuring Agency has agreed to advance to the Contractor, at the Contractor's request, an amount of Rupees (Rs) which amount shall be advanced to the Contractor as per provisions of the Contract.

AND WHEREAS, the Procuring Agency has asked the Contractor to furnish Guarantee to secure the mobilization advance for the performance of his obligations under the said Contract.

AND WHEREAS, _____
(Scheduled Bank in Pakistan)
(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Procuring Agency agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

NOW, THEREFORE, the Guarantor hereby guarantees that the Contractor shall use the advance for the purpose of above mentioned Contract and if he fails and commits default in fulfillment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Procuring Agency for payment not exceeding the aforementioned amount.

Notice in writing of any default which the Procuring Agency shall be the sole and final judge, on the part of the Contractor, shall be given by the Procuring Agency to the Guarantor, and on such first written demand, payment shall be made by the Guarantor of all sums then due under this Guarantee without any reference to the Contractor and without any objection.

This Guarantee shall remain in force until the advance is fully adjusted against payments from the Interim Payment Certificates of the Contractor or until _____ whichever
(Date)
is earlier. The Guarantor's liability under this Guarantee shall not in any case exceed the sum of Rupees _____ (Rs _____).

This Guarantee shall remain valid up to the aforesaid date and shall be null and void after the aforesaid date or earlier if the advance made to the Contractor is fully adjusted against payments from Interim Payment Certificates of the Contractor provided that the Guarantor agrees that the aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

GUARANTOR

1. Signature _____
2. Name _____
3. Title _____

WITNESS

1. _____
Corporate Secretary (Seal)

2. _____ _____
(Name Title & Address) Corporate Guarantor (Seal)

INDENTURE FOR SECURED ADVANCES

(For use in cases in which this contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time).

This INDENTURE made the …….. day of ..... 20……..…… BETWEEN ……(hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and ……..(hereinafter called the Procuring Agency of the other part).

WHEREAS by an agreement, dated (hereinafter called the said agreement, the contractor has agreed to perform the under-mentioned works (hereinafter referred to as the said work).

.....

(Here enter (the description of the works)

AND WHEREAS the contractor has applied to the Procuring Agency for an advance to him of Rupees ……..…… (Rs. .....) on the security of materials absolutely belonging to him and brought by him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charge) AND WHEREAS the Procuring Agency has agreed to advance to the Contractor the sum of Rupees, (Rs. .....) on the security of materials the quantities and other particulars of which are detailed in Part II of Running Account Bill (B) the said works signed by the contractor Fin R.Form.l7.A.

On ……. and on such covenants and conditions as are hereinafter contained and the Procuring Agency has reserved to itself the option of marking any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

NOW THIS INDENTURE WTTNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees……..(Rs. ……) on or before the execution of these presents paid to the Contractor by the Procuring Agency (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid (all of which advances are hereinafter collectively referred to as the said amount) the Contractor doth hereby assign unto the Procuring Agency, the said materials by way of security for the said amount

And doth hereby covenant and agree with the Procuring Agency and declare ay follow:-

(1) That the said sum of Rupees. …… (Rs. ……) so advanced by the Procuring Agency to the Contractor as aforesaid and all or any further sum or sums which may be advanced as aforesaid shall be employed by the contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Running Account Bill (B) which have been offered to and accepted by the Procuring Agency as security for the said amount are absolutely by the Contractors own property free from encumbrances of any kind and the Contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the contractor hereby agrees, at all times,

to indemnify and save harmless the Procuring Agency against all claims whatsoever to any materials in respect of which an advance has been made to him as aforesaid.

(3) That the said materials detailed in the said Running Account Bill (B) and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Engineer (hereinafter called the Engineer) and in the terms of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangement for the proper watch, safe custody and protection against all risks of the said material and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and at his own risk and on his own responsibility and shall at all times be open to inspection by (he Engineer or any representative authorized by him. In the event of the said materials of any part (hereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof Contractor will forthwith replace the same with other materials of like quality or repair and make good the same as required by the Engineer and the materials so brought to replace the said materials so repaired and made good shall also be considered as security for the said amount.

(5) Hurt the said materials shall not on any account be removed from the site of the said works except with the written permission of the Engineer or a representative authorized by him in that behalf.

(6) That the said amount shall be payable in full when or before the Contractor receives payment, from the Procuring Agency of the price payable to him for the said works under the terms and provisions of the said agreement PROVIDED THAT if any intermediate payments are made to the contractor on account of work done then on the occasion of each such payment the Procuring Agency will be at liberty to make a recovery from the Contractors Bill for such payment by deducting there from in the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously the value for this purpose being determined in respect of each description of material at the rates at which the amount of the advances made under these presents were calculated.

(7) that if the Contractor shall at any time make any default in the performance or observation in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the Procuring Agency shall immediately on the happening of such default be repayable by the Contractor to the Procuring Agency together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date or repayment and with all costs, charges, damages and expenses incurred by the Procuring Agency in or for the recovery thereof or the enforcement of this security or otherwise by reason of (he default of the Contractor and any moneys so becoming due and payable shall constitute a debt due from the Contractor to the Procuring Agency and the Contractor hereby covenants and agrees with the Procuring Agency to repay and the same respectively to it accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the Procuring Agency of the said sum of Rupees.....

(Rs. ....) and any further sum or sums which may be advanced as aforesaid and all costs, charges, damages and expenses payable under these present PROVIDED ALWAYS and it is hereby agreed and declared that not, withstanding anything in the said agreement and without prejudice to the powers contained therein if and whether the covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly. Once there with the Procuring Agency may at any time thereafter adopt all or any of following courses as it may deem best ;-

(a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay the same to the Procuring Agency on demand.

(b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the Procuring Agency under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except as is expressly provided by the presents interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be referred to the Engineer whos decision shall be final and the provisions of the Arbitration Act 1940 for the time being in force so far as they are applicable shall apply to any such reference.

Singed, sealed and delivered by*
In the presence of

SEAL

1st Witness _____

2nd Witness _____

PART - I GENERAL CONDITIONS OF CONTRACT

Notes on the Conditions of Contract

The Conditions of Contract comprise two parts:

(a) **Part I - General Conditions of Contract**
(b) **Part II - Special Conditions of Contract**

Over the years, a number of "model" General Conditions of Contract have evolved. The one used in these Standard Bidding Documents was prepared by the International Federation of Consulting Engineers (Federation International des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract. (The used version is the harmonized Edition March 2006).

The FIDIC Conditions of Contract have been prepared for an ad measurement (unit price or unit rate) type of contract, and cannot be used without major modifications for other types of contract, such as lump sum, turnkey, or target cost contracts.

The standard text of the General Conditions of Contract chosen must be retained intact to facilitate its reading and interpretation by bidders and its review by the procuring agency. Any amendments and additions to the General Conditions, specific to the contract in hand, should be introduced in the Particular Conditions of Contract.

The use of standard conditions of contract for all civil works will ensure comprehensiveness of coverage, better balance of rights or obligations between procuring agency and Contractor, general acceptability of its provisions, and savings in time and cost for bid preparation and review, leading to more economic prices.

The FIDIC Conditions of Contract are copyrighted and may not be copied, faxed, or reproduced. Without taking any responsibility of its being accurate, Pakistan Engineering Council with prior consent of FIDIC Secretariat, has reproduced herein the FIDIC General Conditions of Contract for reference purpose only which cannot be used by the users for preparing their bidding documents. The bidding document may include a purchased copy, the cost of which can be retrieved as part of the selling price of the bidding document. and the successful bidder will obtain/purchase copy directly from FIDIC and should provide proof of such purchase.* This purchased copy of FIDIC Conditions of Contract shall be made part of the Contract Agreement. However at this moment Bidder is in default compliance of these FIDIC Condition of Contracts

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* Add the following text if the bidding documents, as issued, do not include a copy:

"Copies of the FIDIC Conditions of Contract can be obtained from:
To request such permission please contact:
FIDIC CASE POSTALE, CH-1215 Switzerland;
Tel. +41 22 799 49 00;
Fax; +41 22 799 49 01
E-mail: fidic@fidic.org.

CONDITIONS OF CONTRACT FOR CONSTRUCTION

FOR BUILDING AND ENGINEERING WORKS DESIGNED BY THE EMPLOYER

Multilateral Development Bank Harmonised Edition March 2006

General Conditions

FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS
INTERNATIONAL FEDERATION OF CONSULTING ENGINEERS
INTERNATIONALE VEREINIGUNG BERATENDER INGENIEURE
FEDERACION INTERNACIONAL DE INGENIEROS CONSULTORES

Conditions of Contract
for **CONSTRUCTION**

FOR BUILDING AND ENGINEERING
WORKS DESIGNED BY THE EMPLOYER
Multilateral Development Bank Harmonised
Edition March 2006
General Conditions

NOTE: Successful bidder will obtain/purchase original copy directly from FIDIC and should provide proof of such purchase. This purchased copy of FIDIC Conditions of Contract shall be made part of the Contract Agreement. However at this moment Bidder is in default compliance of these FIDIC Condition of Contracts.

FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS
INTERNATIONAL FEDERATION OF CONSULTING ENGINEERS
INTERNATIONALE VEREINIGUNG BERATENDER INGENIEURE
FEDERACION INTERNACIONAL DE INGENIEROS CONSULTORES

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General Provision

1.1
Definitions

In the Conditions of Contract ("these Conditions"), which include Particular Conditions, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1
The Contract

1.1.1.1 "Contract" means the Contract Agreement, the Letter of Acceptance, the Letter of Tender, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 "Contract Agreement" means the contract agreement referred to in Sub-Clause 1.6 [Contract Agreement].

1.1.1.3 "Letter of Acceptance" means the letter of formal acceptance, signed by the Employer, of the Letter of Tender, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression "Letter of Acceptance" means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 "Letter of Tender" means the document entitled letter of tender or letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 "Specification" means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 "Drawings" means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 "Schedules" means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 "Tender" means the Letter of Tender and all other documents which the Contractor submitted with the Letter of Tender, as included in the Contract.

1.1.1.9 "Bill of Quantities", "Daywork Schedule" and "Schedule of Payment of Currencies" mean the documents so named (if any) which are comprised in the schedule.

1.1.1.10 "Contract Data" means the pages completed by the Employer entitled contract data which constitute Part A of the Particular Conditions.

1.1.2
Parties and Persons

1.1.2.1 “Party” means the Employer or the Contractor, as the context requires.

1.1.2.2 “Employer” means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 “Contractor” means the person(s) named as contractor in the Letter of Tender accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 “Engineer” means the person appointed by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer].

1.1.2.5 “Contractor’s Representative” means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor’s Representative], who acts on behalf of the Contractor.

1.1.2.6 “Employer’s Personnel” means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer’s Personnel.

1.1.2.7 “Contractor’s Personnel” means the Contractor’s Representative and all personnel whom the Contractor utilizes on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.8 “Subcontractor” means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.2.9 “DB” means the person or three persons appointed under Sub-Clause 20.2 [Appointment of the Dispute Board] or Sub-Clause 20.3 [Failure to Agree on the Composition of the Dispute Board].

1.1.2.10 “FIDIC” means the Federation Internationale des Ingenieurs-Conseils, the international federation of consulting engineers.

1.1.2.11 “Bank” means the financing institution (if any) named in the Contract Data.

1.1.2.12 “Borrower” means the person (if any) named as the borrower in the Contract Data.

1.1.3
Dates, Tests, Periods and Completion

1.1.3.1 “Base Date” means the date 28 days prior to the latest date for submission and completion of the Tender.

1.1.3.2 “Commencement Date” means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 “Time for Completion” means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 “Tests on Completion” means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 “Taking-Over Certificate” means a certificate issued under Clause 10 [Employer’s Taking Over].

1.1.3.6 “Tests after Completion” means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 “Defects Notification Period” means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], which extends over twelve months except if otherwise stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 “Performance Certificate” means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.4
Money and Payments

1.1.4.1 “Accepted Contract Amount” means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

1.1.4.2 “Contract Price” means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.

1.1.4.3 “Cost” means all expenditure reasonably incurred (or to be incurred) by the charges, but does not include profit.

1.1.4.4 “Final Payment Certificate” means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 “Final Statement” means the statement defined in Sub-Clause 14.11 ［Application for Final Payment Certificate]

1.1.4.6 “Foreign Currency” means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 “Interim Payment Certificate” means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 “Local Currency” means the currency of the Country.

1.1.4.9 “Payment Certificate” means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 “Provisional Sum” means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 “Retention Money” means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 “Statement” means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5
Works and Goods

1.1.5.1 “Contractor’s Equipment” means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor’s Equipment excludes Temporary Works, Employer’s Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 “Goods” means Contractor’s Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 “Materials” means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 “Permanent Works” means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 “Plant” means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works, including vehicles purchased for the Employer and relating to the construction or operation of the Works.

1.1.5.6 “Section” means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 “Temporary Works” means all temporary works of every kind (other than Contractor’s Equipment) required on Site for the execution and completion of the permanent Works and the remedying of any defects.

1.1.5.8 “Works” mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6
Other Definitions

1.1.6.1 “Contractor’s Documents” means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 “Country” means the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 “Employer’s Equipment” means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 “Force Majeure” is defined in Clause 19 [Force Majeure].

1.1.6.5 “Laws” means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 “Performance Security” means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 “Site” means the places where the Permanent Works are to be executed, including storage and working areas, and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 “Unforeseeable” means not reasonably foreseeable by an experienced contractor by the Base Date.

1.1.6.9 “Variation” means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].

1.2
Interpretation in the Contract, except where the context requires otherwise:

a. words indicating one gender include all genders;
b. words indicating the singular also include the plural and words indicating the plural also include the singular;
c. provisions including the word “agree”, “agreed” or “agreement” require the agreement to be record in writing;
d. “written” or “in writing” means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and
e. The word “tender” is synonymous with “bid”, and “tenderer” with “bidder” and the words “tender documents” with “bidding documents".

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression “Cost plus profit” require this profit to be one- twentieth (5%) of this cost unless otherwise indicated in the Data.

1.3
Communications

Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and
(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or

the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4
Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the contract.

1.5
Priority of Documents

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

(a) the Contract Agreement (if any),
(b) the Letter of Acceptance,
(c) the Tender,
(d) the particular Condition- Part- A
(e) the particular Condition – Part- B
(f) these General Condition
(g) the Specification
(h) the Drawings and
(i) the Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

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PART – II SPECIAL/PARTICULAR CONDITIONS OF CONTRACT

PART II - SPECIAL /PARTICULAR CONDITIONS OF CONTRACT

1.1 Definitions

1.1.1.1 "Bidding" is synonymous with "Contract".

1.1.1.4 "Form of Bid" is synonymous with "Letter of Tender".

1.1.1.8 "Bid" is synonymous with "Tender".

1.1.1.10 "Contract Data" " is synonymous with "Particular Conditions of Contract and Sections/references referred therein including all relevant appendices and forms"

The following sub-clauses are added:

1.1.1.11 "Programme" means the Programme to be submitted by the contractor in accordance with Sub-Clause 8.3 and any approved revisions thereto.

1.1.1.12 In this Contract Document wherever the word "Bank/Donor Agency/Funding Agency or word(s) having similar meanings" are used shall be read as "Employer"

1.1.2.2 "Employer" is synonymous with "Procuring Agency"

The Procuring Agency is:
The Program Management Unit (PMU)
USAID-Sindh MSDP
D-18, Block-2, Kehkashan, Clifton
Karachi.
Tel: 021-35810017-18

1.1.2.4 The Engineer is:
M/S RCC Consultants
RCC complex, Ground Floor, Main Road Qasimabad Hyderabad
Tel: 022-2652957,2650709

1.1.2.9 "DB" is synonymous with "Committee".

1.1.3.1 Replace 28 days by 7 days in LCB and 15 days in ICB.

1.1.3.7 "Defects Notification Period" is synonymous with "Defects Liability Period".

1.1.3.8 'Performance Certificate" is synonymous with "Defects Liability Certificate".

1.1.4 Money and Payments

1.1.4.2 "Contract Price" means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works subject to such additions thereto or deductions there from as may be made and remedying any defects therein in accordance with the provisions of the Contract.

1.1.4.13 "Delay Damages" is synonymous with "Liquidated Damages"

1.3 Law and Language

Sub-clause 1.4 is deleted and substituted with the following:

a) The Contract Documents shall be drawn up in the English language.
b) The Contract shall be subject to the Laws of Islamic Republic of Pakistan.

1.5 Priority of Contract Documents

The documents listed at (a) to (i) of this sub-clause are deleted and substituted with the following:

i. The Contract Agreement (if completed);
ii. The Letter of Acceptance;
iii. The completed Form of Bid;
iv. Special Stipulations (Appendix-A to Bid);
v. The Particular Conditions of Contract-Part II;
vi. The General Conditions of Contract-Part I;
vii. The priced Bill of Quantities (Appendix-D to Bid);
viii. The completed Appendices to Bid (B, C, E to M);
ix. The Drawings;
x. The Specifications;
xi. EMMP, and
xii. (any other)

In case of discrepancies between drawings, those of larger scale shall govern unless they are superseded by a drawing of later date regardless of scale. All Drawings and Specifications shall be interpreted in conformity with the Contract and these Conditions. Addendum, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

1.6 Contract Agreement

Text of this Sub-clause 1.6 is deleted and substituted with the following:

Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Procuring Agency will send the successful bidder the Contract Agreement in the form provided in the bidding documents, incorporating all agreements between the parties.

The formal agreement between the Procuring Agency and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the Successful bidder from the Procuring Agency.

The Contractor shall also pay the stamp duty/excise duty in accordance with the Government Rules enforced at the time of executing the Contract Agreement. The cost incurred for the execution of the Contract Agreement and stamp/excise duties shall be borne by the Contractor and would be included in his contract rates and no separate payment shall be made on this account.

In case of any increase in Contract Price due to variation, claims and any other reason(s), the amount of additional stamp duty/excise duty shall be recovered from Contractor at the completion of the project.

The following sub-clauses 1.16 and 1.17 are added:

1.16 Shop Drawings

The Contractor shall submit to the Engineer for review three (3) copies of all shop and erection drawings applicable to this Contract pursuant to this sub-clause and as per provisions of other relevant clauses/sub-clauses of the Contract.

Review and approval by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory and that the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

The cost of shop drawings shall be deemed to be included in the rates and prices of the Contract.

1.17 As-Built Drawings

At the completion of the Works under the Contract, the Contractor shall furnish to the Engineer six (6) hard copies, one soft copy based on GIS on compact disc all drawings amended to conform the Works as-built. The cost of such drawings shall be deemed to be included in the Contract Price.

2.4 Employer' Financial Arrangement

Text of this sub-clause 2.4 is deleted and substituted with the following:

The procurement of all construction services for water, wastewater, and solid waste infrastructure in Jacobabad City will be the responsibility of the Project Management Unit (PMU) which has been established by Government of Sindh (GoS) whereas the USAID is providing a fund to the Government of Pakistan for these services as well as Government of Sindh also arranged funds as share to this Program for all eligibility payment to the Contractor. Through the use of Cost Reimbursement (CR), USAID will reimburse the Government of Sindh for the cost of these projects. The part of the funds will be used towards the cost of this project and to cover eligible payments under the Contract for the Works.

The following sub-clause 2.6 is added:

2.6 Notices to Employer

For the purpose of this sub-clause, the address is:

The Program Management Unit (PMU)
USAID-Sindh MSDP
D-18, Block-2, Kehkashan, Clifton
Karachi
Tel:021-35810017-18

3.1 Engineer's Duties and Authority.

The following text is added after duties:

Procuring Agency shall ensure that the Engineer's Representative/Staff is a professional engineer as defined in the Pakistan Engineering Council Act 1975 (V of 1976).

With reference to sub-clause 3.1, the following provisions shall also apply and the Engineer shall obtain specific approval of the Employer before carrying out his duties in accordance with these provisions:

i. Determinations under sub-clause 3.5
ii. Any action under Clause 4.2–Performance Security and Clause 18– Insurance.
iii. Consenting to the sub-letting of any part of the Works under sub-clause 4.4– Subcontractors and under Clause 5 – Nominated Subcontractor.
iv. Any action under sub-clause 8.4 – Extension of Time for Completion.
v. Any action under sub-clause 8.7 – Delay Damages
vi. Any action under sub-clauses 8.8 – Suspension of Work, 8.9 – Consequences of Suspension, 8.10 – Payment for Plant and Materials in Event of Suspension, and 8.11 – Prolonged Suspension.
vii. Issuance of "Taking over Certificate" under Clause 10.
viii. Issuance of "Performance Certificate" under sub-clause 11.9.
ix. Issuing a Variation Order under Clause 13, except
   a) In emergency situation, (as stated below)*
   b) If such variation would increase Contract Price by less than the amount stated in the Appendix-A to Bid.
x. Release of Retention Money to the Contractor under sub-clause 14.9 – Payment of Retention Money.
xi. Issuance of "Final Payment Certificate" under sub-clause 14.13.
xii. Extra payment as a result of Contractor's claims under Clause 20.
xiii. Certifying additional cost determined under sub-clause 4.12 "Un-foreseeable physical conditions."

* *(If in the opinion of the Engineer, an emergency occurs affecting the safety of the life of the Works or of adjoining property, the Engineer may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 12.3 and shall notify the Contractor accordingly, with a copy to the Employer.)*

The following sub-clause 3.6 is added:

3.6 Engineer Not Liable

Approval, reviews and inspection by the Engineer of any part of the Works does not relieve the Contractor from his sole responsibility and liability for the supply of materials, plant and equipment for construction of the Works and their parts in accordance with the Contract and neither the Engineer's authority to act nor any decision made by him in good faith as provided for under the Contract whether to

exercise or not to exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any of their representatives or employees or any other person performing any portion of the Works.

The following sub-clause 3.7 is added:

3.7 Notice to Engineer

For the purpose of this sub-clause, the address is:

Shall be notified along with the issuance of Work order

4.2 Performance Security

The following text is added to this sub-clause:

The Contractor shall provide the Performance Security to the Employer in the prescribed format. The Performance Security shall be of an amount equal to 5% of the Contract Price stated in the Letter of Acceptance. Such Security shall be at the option of the bidder, be in the form of either (a) bank guarantee from any Scheduled Bank in Pakistan, or (b) bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan. The Performance Security shall remain valid upto 28 days beyond the expiry of Defects Liability Period and shall be released within 28 days after receiving a copy of Performance Certificate.

The cost of complying with the requirements of this sub-clause shall be borne by the Contractor.

In the 1st line of second paragraph replace 28 by 07.

In the 3rd line of last paragraph replace 25 by 15.

The following sub-clause 4.2 (a) is added:

4.2 (a) Performance Security binding on Variations and Changes

The Performance Security shall be binding irrespective of changes in quantities or variations in the Works or extensions in Time for Completion which are granted or agreed upon under the provisions of the Contract.

4.3 Contractor's Representative

The following text is to be added after last line:

The contractor's authorized representative and his other professional engineers working at site shall register themselves with the Pakistan Engineering Council.

The Contractor's authorized representative at Site shall be authorized to exercise adequate administrative and financial powers on behalf of the Contractor so as to achieve completion of the Works as per Contract.

The Contractor's authorized representative shall be fluent in the English language. Alternatively, an interpreter with ability of English language shall be provided by the Contractor on full time basis.

4.6 Co-operation

The following text is added to the last line of this sub-clause:

During the execution of the Works, the Contractor shall co-operate fully with other contractors working for the Employer at and in the vicinity of the Site and also shall provide adequate precautionary facilities not to make himself a nuisance to residents and other contractors.

4.8 Safety Procedures

The following paragraph is added at the end of this sub-clause:
In order to provide measures for the safety , health and welfare of persons, and for the prevention of damage of any kind, all operations for the purpose of or in connection with the Contract shall be carried out in compliance with the Safety Requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorize or direct, and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.
The Contractor shall make, maintain and submit reports to the Engineer concerning safety, health and welfare of persons and damage to property, as the Engineer may from time to time prescribe.

4.11 Sufficiency of the Accepted Contract Amount

The following paragraph is added at the end of this sub-clause:
The Contractor, Subcontractors and their employees shall be responsible for payment of all their income tax, super tax and other taxes on income arising out of the Contract and the rates and prices stated in the Contract shall be deemed to cover all such taxes.

4.13 Rights of Way and Facilities

Following sub para is added at the end of this sub clause:
Employer shall be responsible for dispute free access/ possession of site to the contractors for the execution of work.
Any specific approval required for obtaining right of way for the execution of works shall be obtained by the Employer. However, any financial charges associated with said permission shall be borne by the contractor which will be reimbursed to him upon submission of relevant evidence/vouchers under the provision of contract.

4.15 Access Route

The following paragraph is added at the end of this sub-clause:
Where required, the Contractor shall construct and maintain throughout the duration of the Contract, temporary access roads and any protection works for the safety of temporary works, permanent works and traffic, all at his own cost, which may also include temporary culverts/bridges, if needed

4.17 Contractor's Equipment

The following paragraph is added:
The Contractor shall, upon request by the Engineer at any time in relation to any item of hired Contractor's Equipment, forthwith notify the Engineer in writing the name and address of the Owner of the equipment and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements set forth above.

4.21 Progress Report

During the period of the Contract, the Contractor shall submit to the Engineer not later than the 8th day of the following month, 10 copies each of Monthly Progress Reports covering:

1. A Construction Schedule indicating the monthly progress in percentage;
2. Description of all work carried out since the last report;
3. Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;
4. Monthly summary of daily job record;
5. Photographs to illustrate progress; and
6. Information about problems and difficulties encountered, if any, and proposals to overcome the same.

During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

The following sub-clause 4.23(a) is added:

4.23(a) Lighting Work at Night

In the event of work being carried out at night, the Contractor shall at his own cost, provide and maintain such good and sufficient light as will enable the work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night-work is being carried out shall be sufficiently lighted. All arrangement adopted for such lighting shall be to the satisfaction of the Engineer's Representative.

The following Sub-clause 4.25 is added:

4.25 Notices to Contractor

The Contractor shall, immediately after receipt of Letter of Acceptance, intimate in writing to the Employer and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

The following Sub-Clause 4.26 is added:

4.26 Local Conflicts and Hindrances

If during the execution of Works, the Contractor faces any local conflicts and hindrances with stakeholders then it shall be the responsibility of the Contractor to deal with all such local conflicts and hindrances with stakeholders, and resolve them amicably and timely. If any delays are caused due to these local conflicts and hindrances then in no way such delays shall be accounted for any delay claims.

6.1 Engagement of Staff and Labour

The following paragraph is added at the end of this sub-clause:

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour from sources within Pakistan.

6.3 Persons in the Service of Employer

Delete the text in it's entirely and substitute with the following:

The Contractor shall not recruit his staff and labour from amongst the persons in the services of the Employer or the Engineer; except with the prior written consent of the Employer or the Engineer, as the case may be.

6.7 Health and Safety

The following paragraph is added at the end of this sub-clause:

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the local medical or sanitary authorities, for purpose of dealing with and overcoming the same.

6.8 Contractor's Superintendence

The following paragraph is added at the end of this sub-clause:

A reasonable proportion of the Contractor's superintending staff shall have a working knowledge of the English language. If the Contractor's superintending staff is not fluent in English language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

6.9 Contractor's Personnel

The following paragraph is added at the end of this sub-clause:

Project Manager and other professional engineer employed by the Contractor should be registered engineer with Pakistan Engineering Council (PEC).

6.10 Records of Contractor's Personnel and Equipment

The following paragraph is added at the end of this sub-clause:

The Contractor shall, upon request by the Engineer at any time in relation to any item of hired Contractor's Equipment, forthwith notify the Engineer in writing the name and address of the Owner of the equipment and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements set forth above.

The following sub-clauses 6.23, 6.24 and 6.25 are added in:

6.23 Environmental Mitigation and Monitoring Plan

Environmental Mitigation and Monitoring Plan is attached as Volume-IV with these Contract Documents. The Contractor shall follow and implement this document for necessary compliance in its entirety on the site. Compliance with these conditions will be regularly confirmed and documented.

6.24 Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

6.25 Reporting of Accidents

The Contractor shall report to the Engineer details of any accident as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means.

7.9 Use of Pakistani Materials and Services

The contractor shall, so far as may be consistent with the contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services, available in Pakistan provided such materials, supplies, plant, equipment and services shall be of required standard.

8.1 Commencement of Works

Delete the text and substitute with the following:

The contractor shall commence the works on site within the period stated in Appendix-A to Bid from the date of receipt by him from the Engineer of a written Notice to Commence. Thereafter, the contractor shall proceed with the works with due expedition and without delay.

8.2 Time for Completion

The time for Completion for this work is 120 Calendar Days from the date of issuance of commencement letter by the Engineer.

8.3 Programme

The programme shall be submitted within 14 days from the date of receipt of Letter of Acceptance. The Programme shall be submitted in the either form of, as instructed by the Engineer:

a) Bar Chart identifying the critical activities.

b) Critical Path Method (CPM) identifying the critical path/activities.

Program Evaluation and Review Techniques (PERT).
The Contractor shall submit to the Engineer detailed programme for the following:
Execution of Works;
Labour Employment;

1. Local Material Procurement;
2. Material Imports, if any; and
3. Other details as required by the Engineer.

The following Sub-Chausses 8.3(a) is added:

8.3(a) Cash Flow Estimate to be submitted

The detailed Cash Flow Estimate shall be submitted within 21 days from the date of receipt of Letter of Acceptance.

8.11 Prolonged Suspension

Replace 84 days by 120 days.

10.1 Taking Over of the Works and Sections

Taking over of sections shall only be applicable if separate Times for Completion of different section(s) is provided in the Appendix-A to Bid “Special Stipulations”.

11.0 The Defect Liability

The Defect Liability Period shall be 06 Calendar Months from the date of Completion

12.3 Evaluation

Sub-Para (a) is deleted in its entirety and substituted with following:
If, on the issue of Taking-Over Certificate for whole of the Works, it is found that as a result of:

i. all varied work valued under Clause 12

all adjustments upon measurements of the estimated quantities set out in Bill of Quantities , excluding provisional sums, Daywork and adjustments of price made under Sub-Clause 13.8 but not from any other cause, there have been additions to or deductions from the Contract Price which when taken together are in excess of 15 per cent of the "Effective Contract Price" (which for the purposes of this Sub-Clause shall mean the Contract Price, excluding provisional sums and allowance for Daywork, if any) then and in such event (subject to any action already taken under any other Sub- Clause of this Clause), after due consultation by the Engineer with the Employer and the Contractor, there shall be added to or deducted from the Contract Price such further sum as may be agreed between the Contractor and Employer or, failing agreement, determined by the Engineer having regard to the Contractor's Site and general overhead costs of the Contract. The Engineer shall notify the Contractor of any determination made under this Sub-Clause with a copy to Employer. Such sum shall be based only on the amount by which such additions or deductions shall be in excess of 15 percent of the Effective Contract Price.

13.1 Right to vary

In the last line of Para, after the word "Variation", the word "in writing" is added.

13.3 Variation Procedure

In the tenth line, after the words "as soon as practicable" following is added: "and within a period not exceeding one-eighth of the completion time"

13.7 Adjustment for changes in Legislation

The following paragraph will be added in last paragraph of this sub clause No Adjustment shall be made for the rises and fall in the cost of labor resulting from a change in minimum wages.

13.8 Adjustment for changes in cost

Entirely delete,

14.1 The Contract Price

Sub-para (d), following is added:
"Such breakdown shall be subject to the approval of the Engineer." Sub-para (e) is deleted in it's entirely.

14.2 Advance Payment (Not Applicable)

The Text is entirely deleted

14.3 Application for Interim Payment Certificates

In the first line after the word "shall", the following is added:

"on the basis of the joint measurement of work done under Clause 12.1,"

Replace sub para 14.3(b) with following;

(b) any amount to be added and deducted for changes in legislation and changes in cost , in accordance with sub clause 13.7 and sub clause 13.8 with relevant evidence must be submitted in subsequent interim payment application otherwise the application for interim payment Certificate will not be processed.

Sub-para 14.3 (h), following is added:

(h) Invoices for the material used in the execution (Steel, Cement, Pipes and Pumps, gate valves)

14.5 Plants and Materials intended for Works

Add the following paragraph as sub-clause 14.5 (d) for Secured Advance on non – perishable materials and sub-clauses (a), (b) and (c) will be applicable for plants only:

I. The Contractor shall be entitled to receive from the Procuring Agency Secured Advance against an INDENTURE BOND in Public Works Account Form No.31 (Fin. R. Form No. 2) acceptable to the Procuring Agency of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the site but not yet incorporated in the Permanent Works provided that:

i. The materials are in accordance with the specifications for the permanent works;

ii. Such materials have been delivered to the site and are properly stored and protected against loss or damage or deterioration to the satisfaction and verification of the Engineer but at the risk and cost of the Contractor;

iii. The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;

iv. The Contractor shall submit with his monthly statement the estimated value of the materials on site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefore;

v. Ownership of such materials shall be deemed to vest in the Procuring Agency and these materials shall not be removed from the site or otherwise disposed of without written permission of the Procuring Agency;

vi. The sum payable for such materials on site shall not exceed 75 % of the

(i) Landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of stands of other materials;

vii. Secured Advance shall not be allowed unless and until the previous advance, if any, is fully recovered;

viii. Detailed account of advances must be kept in part II of running account bill or a separate statement; and

ix. Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and in no case for full quantities of materials for the entire work/contract.

II. <u>Recovery of Secured Advance:</u>

Secured Advance paid on non-perishable materials to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized);

14.7 Payment

The text is deleted and substituted with the following:

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall, subject to Clause 8.7, be paid by the Employer to the Contractor within 28 days after such Interim Payment Certificate has been delivered to the Employer, or, in the case of the Final Certificate referred to in Sub Clause 14.13, within 56 days after such Final Payment Certificate has been delivered to the Employer.

14.8 Delayed Payment

The Text of this sub-clause is deleted and substituted with the following:

In the event of the failure of the Employer to make payment within the times stated in sub-clause 14.7, the Employer shall pay to the Contractor compensation at rate of KIBOR, upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 16.

14.9 Payment of Retention Money

The fifth paragraph is deleted

15.2 Termination by Employer

The following Para is added at the end of the sub-clause

Provided further, that in addition to the action taken by the Procuring Agency against the Contractor under this Clause, the Procuring Agency may also refer the case of default of the Contractor to Pakistan Engineering Council for punitive action under the Construction and Operation of Engineering Works Bye-Laws 1987, as amended from time to time.

If the Contractor or any of his Subcontractors, agents or servants is found to have violated or involved in violation of the Integrity Pact signed by the Contractor as

Appendix-L to his Bid, then the Employer shall be entitled to:

a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agents or servants;

b) terminate the Contract; and

c) recover from the Contractor any loss or damage to the Employer as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

The termination under Sub-Para (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clauses 15.2 to 15.4 and the payment under Sub-Clause 15.4 shall be made after having deducted the amounts due to the Employer under Sub- Para (a) and (c) of this Sub-Clause.

16.1 Contractor's Entitlement to Suspend Work

Following text is deleted from second and third lines starting from:
"or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements]".

16.2 Termination by Contractor

(a) Deleted
(h) The following text is deleted from first and second lines starting from:
"the Bank suspends---------- are being made"

16.4 Payment on Termination

Sub Paragraph (c) is deleted.

17.1 Following sub-clause 17.1 (c) is added after 17.1 (b):
(c) The Contractor or his Subcontractors or assigns shall follow strictly, all relevant labour laws including the Workmen's Compensation Act and the Employer shall be fully indemnified for all claims, damages etc. arising out of any dispute between the Contractor, his Subcontractors or assigns and the labour employed by them.

18.1 General Requirements for Insurances

The following text is added in Clause 18.1 (GCC):

The contractor shall be obliged to place all insurances relating to the contract (including, but not limited to, the insurances referred to in Clauses 18.1, 18.2, 18.3, and 18.4) with Insurance Company having at least AA rating from PACRA/JCR in favor of the Employer//Procuring Agency valid for a period 28 days after/beyond the Defects Liability Period. Costs of such insurances shall be borne by the contractor.

a) The Contractor shall provide evidence to the Employer prior to the start of work at the Site that the insurances required under the Contract have been effected.

b) The Contractor within 60 days of the Commencement Date, provide the insurance policies to the Employer.

Paragraph 10 is deleted and substituted as follows:
"If the Contractor fails to effect and keep in force any of the insurances required under the Contract, or fails to provide the policies to the Employer within the period required by Sub-Clause 18.1 hereof, then and in any such case the Employer may effect and keep in force any such insurances and pay any premium as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or to become due to the Contractor, or recover the same as a debt due from the Contractor."

19.6 Optional Termination, Payment and release by the Employer
Sub-clauses (c), (d) and (e) are deleted.

20.2 Appointment of Dispute Board

Following is added at the end of Sub-Clause 20.2:

The Dispute Board may be appointed by the parties during the course of the contract as and when dispute arises requiring the constitution of such a board.

20.3 Failure to agree on the Composition of Dispute Board

In case of disagreement in terms of Para a, b, c & d of this Sub-Clause, upon the request of either or both parties, the Project Director, PMU may appoint the third member of the board in consultation with contracting parties.

20.6 Arbitration

Text will be replaced as under;

Any dispute in respect of which:

a) the decision, of the Dispute Board has not become final and binding pursuant to sub- clause 20.2, and

b) amicable settlement has not been reached within the period stated in sub-clause 20.5, shall be finally settled, under the provisions of the Arbitration Act, 1940 as amended or any statutory modification/Rules of Conciliation And Arbitration, PEC, Islamabad or re-enactment thereof for the time being in force.

The place of arbitration shall be Karachi, in Sindh Province, Islamic Republic of Pakistan.

Program Management Unit (PMU)
Municipal Services Delivery Program (MSDP)
P&D Department, Government of Sindh

Sindh Municipal Services Delivery Program (MSDP)

CONTRACT PACKAGE AWW-01

REHABILITATION/ STRENGTHENING OF EXISTING OXIDATION PONDS (ZONE-A, B & D)

BIDDING DOCUMENTS
(Single Stage Single Envelope)

VOLUME- I (B)

FORM OF BID
APPENDICES INCLUDING BOQ

APRIL – 2023

Issued to: _____ **Dated:** _____

FORM OF BID

AND

APPENDICES TO BID

Letter of Technical Bid

Date: .....

Bid Reference No: .....
(Name of Contract/Works)

To:.....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents,including Addenda issued in accordance with Instructions to Bidders (IB) 9;

(b) We offer to execute and complete in conformity with the Bidding Documents the following Works:

(c) Our Bid consisting of the Technical Bid and the Financial Bid shall be valid for a period of …… days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) As security for due performance of the under takings and obligations of our bid, we submit here with a Bid security, in the amount specified in Bidding Data Sheet, which is valid (at least) 28 days beyond validity of Bid itself.

(e) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process, other than alternative offers submitted in accordance with IB16 (as applicable).

(f) We agree to permit Employer or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors. This permission is extended for verification of any information provided in our Technical Bid which comprises all documents enclosed herewith in accordance with IB.11.1 of the Bidding Data Sheet.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

.....

Address……..

FB-1

FORM OF BID

Bid Reference No. _____
(Name of Contract / Works)

To:

_____
_____
_____

1. Having examined the bidding documents including Instructions to Bidders, Bidding Data, and Conditions of Contract, Specifications, Drawings and Bill of Quantities and Addenda Nos. _____ for the execution of the above-named work, we/I, the undersigned, offer to execute and complete the work and remedy any defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Bill of Quantities and Addenda for the sum of Rs. _____ (Rupees _____) or such other sum as may be ascertained in accordance with the said conditions.

2. We/I understand that all the Appendices attached hereto form part of this bid.

3. As security for due performance of the undertakings and obligations of this bid, we/I submit herewith a bid security in the amount of Rs. _____ (Rupees _____) drawn in your favour or made payable to Procuring Agency and valid for a period of days beginning from the date, bid is opened.

4. We/I undertake, if our bid is accepted, to commence the works and to complete the whole of the works comprised in the contract within the time stated in Appendix-A to Bid.

5. We/I agree to abide by this bid for the period of days from the date fixed for opening the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

6. Unless and until a formal Agreement is prepared and executed, this bid, together with your written acceptance thereof, shall constitute a binding contract between us.

7. We do hereby declare that the bid is made without any collusion, comparison of figures or arrangement with any other bidder for the works.

8. We understand that you are not bound to accept the lowest or any bid you may receive.

9. We undertake, if our/my bid is accepted, to execute the Performance Security referred to in Clause 4.2 of Conditions of Contract for the due performance of the Contract.

10. We confirm, if our bid is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the procuring agency.
(Please delete this in case of Bid form a single bidder)

in the capacity of_____ duly authorized to sign Bids for and on behalf of

Dated this_____ day of_____

Signature:_____

_____
(Name of Bidder in Block Capitals)
(Seal)

Address:_____
_____
_____

Witness:

Signature:_____
Name: _____

Address:_____
_____

Occupation:_____

BA-1
Appendix-A to Bid

SPECIAL STIPULATIONS
Clause
Conditions of Contract

1.	Engineer's representing Consulting Firm hired by the procuring agency to issue variation in case of emergency	3.1	Up to 2% of the Contract Price stated in the Letter of Acceptance.
2.	Amount of Performance Security	4.2	The Performance Security shall be in the form of an "unconditional, irrevocable and acceptable" Bank Guarantee from scheduled Bank " for an amount of 5% (Five percent) of the Contract Price Stated in the Letter of Acceptance.
3.	Time for Furnishing Programme	8.3	Within 28 days from the date of receipt of Letter of Acceptance.
4.	Minimum amount of Third Party Insurance	18.3	**Type of Cover** Third Party-injury to persons and damage to property The Third Party compensation policy must contain following conditions of indemnification per occurrence with the number of occurrence unlimited: i) In case of death, Rs.1,000,000 per person. ii) In case of major injury, Rs.500,000 per person. iii) In case of minor injury, Rs.100,000 per person. iv) In case of damage to property, full amount of repair/replacement, as the case may be. **Workers:** i) In case of death, Rs.1,000,000 per person. ii) In case of major injury, Rs.500,000 per person. iii) In case of minor injury, Rs.100,000 per person.

5.	Time for Commencement	8.1	Within 07 days from the date of receipt of Engineer's Notice to Commence, this shall be issued within seven (07) days after signingof Contract Agreement.
6.	Time for Completion (works & sections)	8.2 & 10.2	120 Calendar days from the date of receipt of Engineer's Notice to Commence.
7.	Amount of Liquidated Damages/ Delay / Damages/Penalties	8.7	Rs.**(a)*** for each day of delay in completion of the Works subject to a maximum of 10% of Contract Price stated in the Letter of Acceptance, where ***(a) = 10% of Evaluated Bid Price/(0.25 x Time for Completionin days).**
8.	Defects Liability Period	11.1	**180** days from the effective date of Taking Over Certificate.
09.	Percentage of Retention Money	14.3	10 % of the amount of Interim/ Running Payment Certificate.
10.	Limit of Retention Money`	14.3	5 % of Contract Price stated in the Letter of Acceptance.
11.	Minimum amount of Interim/ Running Payment Certificates (Running Bills)	14.6	3% of the Accepted Contract Amount excluding Final Payment Certificate
12.	Time of Payment from delivery of Engineer's Interim/ Running Payment Certificate to the Employer.	14.7	28 days

BB-1
Appendix-B to Bid

FOREIGN CURRENCY REQUIREMENTS

1. The bidder may indicate herein below his requirements of foreign currency (if any), with reference to various inputs to the works.

2. Foreign Currency Requirement as percentage of the bid price excluding Provisional Sums %.

3. Table of Exchange Rates

Unit of Currency	**Equivalent in Pak. Rupees**
Australian Dollar	----------
Euro	----------
Japanese Yen	----------
U.K. Pound	----------
U.S. Dollars	----------
----------	----------
----------	----------

(DELETED)

BC-1
Appendix-C to Bid

PRICE ADJUSTMENT UNDERCLAUSE 13.8 OF CONDITIONS OF CONTRACT

SCHEDULE OF BASIC PRICES OF SPECIFIED MATERIALS

Basic Price of Materials (To be filled by the Bidder)

We confirm herewith that the following prices were prevailing on the day 7 days prior to the tender closing date and have been taken as a basis for quoting the prices given in our Bid/Tender.

Adjustment of increase/decrease in price shall only be admissible for the materialslisted hereunder.

Schedule of Specified Materials

S. No	Materials	Unit	Basic Price	Remarks (For adjustment over basic price on the basis of rate for the corresponding month during which the quantities have actually been incorporated in the permanent work.)
1	2	3	4	5
1.	NOT APPLICABLE			
2.				

Notes:

1) If the price for any of the Specified Materials shall differ from the basic price thereof and shall cause an increase or decrease of cost to the Contractor in carrying out the Contract, the increase or decrease of such cost shall be added to or deducted from the Contract Price. The said increase or decrease in the Contract Price shall be computed on the basis of quantities actually measured and certified for payment. Any fluctuation in the prices of materials other than the Specified Materials shall not be subject to adjustment of the Contract Price.

2) Basic Price in the above table w.r.t. the source to be filled in by the bidder. Basic Prices filled in by the bidder at bidding stage shall be verified and if required shall be corrected / amended, at the time of its application, by the Engineer as per the prices prevailing seven (7) days before the latest date of tender submission from the indicated source.

BILL OF QUANTITIES

PREAMBLE TO BILL OF QUANTITIES

BD-1

Appendix-D to Bid

BILL OF QUANTITIES

A. Preamble

1. The Bill of Quantities shall be read in conjunction with the Conditions of Contract, Specifications and Drawings.

2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work executed and measured by the Contractor and verified by the Engineer and valued at the rates and prices entered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix as per the Contract (in case of item not mentioned in Bill of Quantities).

3. The rates and prices entered in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the contract include all costs of contractor's plant, labour, supervision, materials, execution, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the contract. Furthermore all duties, taxes and other levies payable by the contractor under the contract, or for any other cause, as on the date 14 days prior to deadline for submission of Bids, shall be included in the rates and prices and the total bid price submitted by the bidder.

4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the contractor will have failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities and shall not be paid separately.

5. The whole cost of complying with the provisions of the Contract shall be includedin the items provided in the priced Bill of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the works.

6. General directions and description of work and materials are not necessarily repeated nor summarised in the Bill of Quantities. References to the relevant sections of the bidding documents shall be made before entering prices against each item in the priced Bill of Quantities.

7. Provisional sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with sub-clause 13.5 of Part I, General Conditions of Contract.

BD-DWL
Appendix-D to Bid

BILL OF QUANTITIES

B. Day work ScheduleGeneral

1. Reference is made to Sub-Clause 13.6 of the General Conditions of Contract. Work shall not be executed on a day work basis except by written order of the Engineer. Bidders shall enter basic rates for day work items in the Schedules, which rates shall apply to any quantity of day work ordered by the Engineer. Nominal quantities have been indicated against each item of day work, and the extended total for day work shall be carried forward to the bid price.

Day work Labour

2. In calculating payments due to the contractor for the execution of day work, the actual time of classes of labour directly doing the day work ordered by the Engineer and for which they are competent to perform will be measured excluding meal breaks and rest periods. The time of gangers (charge hands) actually doing work with the gang will also be measured but not the time of foreman or other supervisory personnel.

3. The contractor shall be entitled to payment in respect of the total time that labour is employed on day work, calculated at the basic rates entered by him in the Schedule of day work Rates for labour together with an additional percentage, payment on basic rates representing the contractor's profit, overheads, etc., as described below:

   a) the basic rates for labour shall cover all direct costs to the contractor, including (but not limited to) the amount of wages paid to such labour, transportation time, overtime, subsistence allowances and any sums paid to or on behalf of such labour for social benefits in accordance with Pakistan law. The basic rates will be payable in local currency only; and

   b) the additional percentage payment to be quoted by the bidder and applied to costs incurred under (a) above shall be deemed to cover the contractor's profit, overheads, superintendence, liabilities and insurances and allowances to labour timekeeping and clerical and office work; the use of consumable stores, water, lighting and power; the use and repair of staging's, scaffolding, workshops and stores, portable power tools, manual plant and tools; supervision by the contractor's staff, foremen and other supervisory personnel; and charges incidental to the foregoing.

BD-DWM
Appendix-D to Bid

Day Work Material

4. The contractor shall be entitled to payment in respect of materials used for day work (except for materials for which the cost is included in the percentage addition to labour costs as detailed heretofore), at the basic rates entered by him in the Schedule of Day work Rates for materials together with an additional percentage payment on the basic rates to cover overhead charges and profit, as follows:

   a) the basic rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the site. The basic rates shall be stated in local currency but payment will be made in the currency or currencies expended upon presentation of supporting documentation;

   b) the additional percentage payment shall be quoted by the bidder and applied to the equivalent local currency payments made under Sub-Para(a) above; and

   c) the cost of hauling materials used on work ordered to be carried out as Day Work from the store or stockpile on the site to the place where it is to be used will be paid in accordance with the terms for Labour and Constructional Plant in this Schedule.

BD-DWCP
Appendix-D to Bid

Day Work Constructional Plant

5. The contractor shall be entitled to payments in respect of constructional plant already on site and employed on Day work at the basic rental rates entered by him in the Schedule of Day Work Rates for constructional plant. The said rates shall be deemed to include complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants will be paid for separately as described under the section on Day work Labour.

6. In calculating the payment due to the Contractor for constructional plant employed on Day work, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the traveling time from the part of the site where the constructional plant was located when ordered by the Engineer to be employed on Day Work and the time for return journey thereto shall be included for payment.

7. The basic rental rates for constructional plant employed on Day work shall bestated in Pakistani Rupees.

BOQ

APPENDICES E TO M

BE-1
Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

Pursuant to Sub-Clauses 8.2 and 10.2 of the General Conditions of Contract, the works shall be completed on or before the date stated in Appendix-A to Bid. The bidder shall provide as Appendix-E to Bid, the Construction Schedule in the bar chart (CPM, PERT or any other to be specified herein) showing the sequence of work items and the period of time during which he proposes to complete each work item in such a manner that he proposes to complete each work item in such a manner that his proposed programme for completion of the whole of the works and parts of the works may meet Procuring Agency's completion targets in days noted below and counted from the date Notice to Commence (Attach sheets as required for the specified form of Construction Schedule):

Description	**Time for Completion**
1) Whole Works	_____ days

BF-1
Appendix-F to Bid

METHOD OF PERFORMING THE WORK

The bidder is required to submit a narrative outlining the method of performing the work. The narrative should indicate in detail and include but not be limited to:

1. Organization Chart indicating head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.

2. Mobilization in Pakistan, the type of facilities including personnel accommodation, office accommodation, provision for maintenance and for storage, communications, security and other services to be used.

3. The method of executing the works, the procedures for installation of equipment and machinery and transportation of equipment and materials to the site.

BG-1
Appendix-G to Bid

LIST OF MAJOR EQUIPMENT- RELATED ITEMS

[The bidder will provide on Sheet 2 of this Appendix a list of all major equipment and related items, under separate heading for items owned, to be purchased or to be arranged on lease by him to carry out the works. The information shall include make, type, capacity, and anticipated period of utilization for all equipment which shall be in sufficient detail to demonstrate fully that the equipment will meet all requirements of the Specifications.]

BG-2

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT

Owned Purchased or Leased	Description of Unit (Make, Model, Year)	Capacity HP Rating	Condition	Present Location or Source	Date of Delivery at Site	Period of Work on Project
1	2	3	4	5	6	7
a. Owned						
b. To be Purchased						
c. To be arranged on Lease						

BH-1

Appendix-H to Bid

CONSTRUCTION CAMP AND HOUSING FACILITIES

The Contractor in accordance with Clause 6 of the Conditions of Contract shall provide description of his construction camp's facilities and staff housing requirements.

The contractor shall be responsible for pumps, electrical power, water and electrical distribution systems, and sewerage system including all fittings, pipes and other items necessary for servicing the contractor's construction camp.

The bidder shall list or explain his plans for providing these facilities for the service of the contract as follows:

1. Site Preparation (clearing, land preparation, etc.).

2. Provision of Services.

    a) Power (expected power load, etc.).
    b) Water (required amount and system proposed).
    c) Sanitation (sewage disposal system, etc.).

3. Construction of Facilities

    a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).

    b) Warehouses and Storage Areas (area required, type of construction and layout).

    c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).

4. Construction Equipment Assembly and Preparation (detailed plans for carrying outthis activity).

5. Other Items Proposed (Security services, etc.).

BI-1

Appendix-I to Bid

LIST OF SUBCONTRACTORS

I/We intend to subcontract the following parts of the Work to subcontractors. In my/our opinion, the subcontractors named hereunder are reliable and competent to perform that part of the work for which each is listed.

Enclosed are documentation outlining experience of subcontractors, the curriculum vitae and experience of their key personnel who will be assigned to the Contract, equipment to be supplied by them, size, location and type of contracts carried out in the past.

Part of Works **(Give Details)**	**Subcontractor** **(With Complete Address)**
1	**2**

BJ-1

Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS

Bidder's estimate of the value of work which would be executed by him during each of the periods stated below, based on his Programme of the Works and the Rates in the Bill of Quantities, expressed in thousands of Pakistani Rupees:

Quarter/ Year/ Period	**Amounts (1,000 Rs.)**
1	**2**
1st Quarter	
2nd Quarter	
3rd Quarter	
4th Quarter	
Bid Price	

BK-1

Appendix-K to Bid

ORGANIZATION CHART
FOR THE
SUPERVISORY STAFF AND LABOUR

BL-1

Appendix-L to Bid

QUALITY CONTROL PLAN

The bidder shall provide detail quality control plan identifies the quality assurance/quality control (QA/QC) steps to be used in construction management, including monitoring actions, reporting mechanisms, and documentation formats.

BM-1

Appendix-M to Bid

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC; PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE TO BE SUBMITTED WITH TECHNICAL BID REPRODUCED ON COMPANY LETTER HEAD DULY FILLED & SIGNED)

Contract No._____ Dated _____
Contract Value:_____
Contract Title:_____

…… [name of Contractor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Sindh (GoS) or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoS) through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from, from Procuring Agency (PA) except that which has been expressly declared pursuant hereto.

[name of Contractor] accepts full responsibility and strict liability that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Contractor] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other rights and remedies available to PA under any law, contract or other instrument, be voidable at the option of PA.

Notwithstanding any rights and remedies exercised by PA in this regard, [name of Supplier/Contractor/Consultant] agrees to indemnify PA for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to PA in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from PA.

[Procuring Agency] [Contractor]

Requirements of Classes of Concrete

Class	Cement content (kg/m^3)		Maximum W/C ratio	Cylinder Crushing Strengths Kg/cm^2 (Psi)		Equivalent minimum Ratio
	Minimum	Maximum		Design	Working	
Class “A”	360	440	0.50	386 (5500)	316 (4500)	1:1-1/5:3
Class “A(1)”	420	460	0.48	386 (5500)	316 (4500)	
Class “B”	300	380	0.58	275 (3900)	225 (3200)	1:2:4
Class “B (1)”	320	400	0.52	275 (3900)	225 (3200)	
Class “E”	240	-	0.70	140 (2000)	123 (1750)	1:4:8
Class “E(1)”	300	-	0.70	140 (2000)	123 (1750)	

MUNICIPAL SERVICES PROGRAM (MSP) JACOBABAD.

REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD CONTRACT PACKAGE AWW-01.

BILL OF QUANTITIES

SUMMARY

S#	Descriptions	Amount in Rs.
1	Rehabilitation& Strengthening of Existing Oxidation Ponds Aqil Pur.	
2	Rehabilitation& Strengthening of Existing Oxidation Ponds Ahmed Pur.	
3	Rehabilitation& Strengthening of Existing Oxidation Ponds Jani Dero Jageer.	
4	**Total Amount**	
5	Engineering Consultant (Provisional Sum).	1,970,640.00
	Total Amount Rs.	

Amount in Words:

Total Carried to Bid Form:

SIGNATURE OF CONTRACTOR

SEAL

MUNICIPAL SERVICES PROGRAM (MSP) JACOBABAD.

REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD CONTRACT PACKAGE AWW-01.

BILL OF QUANTITIES

Bill no.1: Rehabilitation& Strengthening of Existing Oxidation Ponds at Aqil Pur.

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
1	Excavation for tanks and reservoirs in slushy or daldally soils i/c trimming and dressing sites to true alignment/design sections/profiles and shape levelling laying of earth in 150mm layer of construction of backs and dressing and disposal of surplus, excavated earth within one chain as directed by engineer incharge i/c providing fence guards, lights, flags were every required lift upto 5ft (1.52m) and lead upto 3 miles etc complete in alol respects as per drawings, Specifications and directions of Engineer..(PHESI#14, P#74)	m3	13200			
2	Full hire charges of the pumping set per day inclusive of wage of driver and Assistant fuel or electric energy plate forms required for placing pumps etc. at lower depth with suction and delivery pipes for pumping out water found at various depths from trenches/tanks i/c the cost of erection and dismantling after completion of the job.(NSI)					
	ii) Hire charges of pumping set of upto 10 H.P pumping out water from upto 4.5meter deep tank/trench.	Per day	180			
3	Excavation in foundation of building bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 1.52m. (b) In Ordinary soil. (GSI#18 (b), P#4)	m3	60.00			
4	Cement concrete plain including placing compacting, finishing and curing, complete (including screening and washing of stone aggregates without shuttering) (I) Ratio 1:4:8 (GSI # 5(i), P# 16)	m3	3.00			
5	Supplying and filling sand under floor and plugging in walls including watering and compaction. Lead upto 6 miles. (GSI# 29, P# 26)	m3	6.00			
6	Coursed Rubble masonry including hammer dressing. (d) In cement sand mortar. (ii) Ratio 1:4 (GSI# 2, P#27)	m3	45.90			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
7	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds: lifting shuttering curing rendering and finishing the exposed surface (including screening and washing of shingle). (a) R.C.C work in roof slab, beams columns rafts, lintels and other structural member laid in situ or precast laid in position complete in all respects. (ii) Ratio (1:1.5:3) GSI# #6 ii, P# 16)	m3	26.80			
8	Fabrication of mild steel reinforcement for cement concrete including cutting, bending, laying in position , making joints and fastenings including cost of binding wire (also includes removal of rust from bars).(b) using Tor bars. (GSI # 8 b, P# 17).	Per Ton	2.84			
9	Earth work embankment from borrow pits including laying in 150mm layers, cold breaking ramming dressing complete, lead upto 6.0 miles & lift upto 1.52m. (In Ordinary soil) (HWSI#5, P#1).	m3	7401.00			
10	Earth work Compaction by sheep foot roller and power roller with optimum moisture content (For 95-100% modified AASHO density (HWSI# 7a, P# 2)	m3	7401.00			
11	Excavation for pipe lines in trenches and pits in soft soils I/c trimming and dressing sides to true alignment and shape leveling of beds of trenches to correct level and grade. Cutting joint holes and disposal of surplus earth within a one chain as directed by Engineer Incharge. providing fence guards, lights flags and temporary crossings for non vehicular traffic where ever required lift upto 5 ft (1.52m) and lead upto one chain (30.50m). (PHS#1, P# 60)	m3	28.80			
12	Providing, Laying RCC Pipes of ASTM C-76-62 T/C-76-70 of Class II wall B and fixing in trench I/c , cutting , fitting and jointing with rubber ring i/c testing with water to specified pressure. (F) 24" dia (600mm). (PHSI# B-1, P#17)	m	60			
13	Refilling the excavated stuff in trenches 150mm thick layer I/c water ramming to full compaction etc complete (PHSI# 24, P# 77)	m3	21.60			
14	Stone Pitching hand packed with surface levelled off to the Correct Section with hammer dressed Stone and voids filled in	m3	603.60			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
	1:8 Cement mortar in floors of bridges and along hands and in aprons etc. including three chains lead. (GSI# 24, P# 32)					
15	Grouting stone pitching or apron in 1:3 cement mortar. (GSI# 12, P# 30)	m2	3760.00			
16	Cost difference of Sulphate Resistant (SRC) cement and Ordinary Portland cement (OPC).	Per Bag	2750			
CARRIED TO COLLECTION						

SIGNATURE OF CONTRACTOR

SEAL

MUNICIPAL SERVICES PROGRAM (MSP) JACOBABAD.

REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD CONTRACT PACKAGE AWW-01.

BILL OF QUANTITIES

Bill no.2: Rehabilitation& Strengthening of Existing Oxidation Ponds at Ahmed Pur.

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
1	Excavation for tanks and reservoirs in slushy or daldally soils i/c trimmng and dressing sites to true alignment/design sections/profiles and shape levelling laying of earth in 150mm layer of construction of backs and dressing and disposal of surplus, excavated earth within one chain as directed by engineer incharge i/c providing fence guards, lights, flags were every required lift upto 5ft (1.52m) and lead upto 3 miles etc complete in alol respects as per drawings, Specifications and directions of Engineer..(PHESI#14, P#74)	m^3	16200			
2	Full hire charges of the pumping set per day inclusive of wage of driver and Assistant fuel or electric energy plate forms required for placing pumps etc. at lower depth with suction and delivery pipes for pumping out water found at various depths from trenches/tanks i/c the cost of erection and dismantling after completion of the job.(NSI)					
	ii) Hire charges of pumping set of upto 10 H.P pumping out water from upto 4.5meter deep tank/trench.	Per day	180			
3	Excavation in foundation of building bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 1.52m. (b) In Ordinary soil. (GSI#18 (b), P#4)	m^3	12.00			
4	Cement concrete plain including placing compacting, finishing and curing, complete (including screening and washing of stone aggregates without shuttering) (I) Ratio 1:4:8 (GSI # 5(i), P# 16)	m^3	0.60			
5	Supplying and filling sand under floor and plugging in walls including watering and compaction. Lead upto 6 miles. (GSI# 29, P# 26)	m^3	1.20			
6	Coursed Rubble masonry including hammer dressing. (d) In cement sand mortar. (ii) Ratio 1:4 (GSI# 2, P#27)	m^3	38.19			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
7	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds: lifting shuttering curing rendering and finishing the exposed surface (including screening and washing of shingle). (a) R.C.C work in roof slab, beams columns rafts, lintels and other structural member laid in situ or precast laid in position complete in all respects. (ii) Ratio (1:1.5:3) GSI# #6 ii, P# 16)	m^3	6.60			
8	Fabrication of mild steel reinforcement for cement concrete including cutting, bending, laying in position , making joints and fastenings including cost of binding wire (also includes removal of rust from bars).(b) using Tor bars. (GSI # 8 b, P# 17).	Per Ton	0.70			
9	Earth work embankment from borrow pits including laying in 150mm layers, cold breaking ramming dressing complete, lead upto 6.0 miles & lift upto 1.52m. (In Ordinary soil) (HWSI#5, P#1).	m^3	7566.16			
10	Earth work Compaction by sheep foot roller and power roller with optimum moisture content (For 95-100% modified AASHO density (HWSI# 7a, P# 2)	m^3	7566.16			
11	Excavation for pipe lines in trenches and pits in soft soils I/c trimming and dressing sides to true alignment and shape leveling of beds of trenches to correct level and grade. Cutting joint holes and disposal of surplus earth within a one chain as directed by Engineer Incharge. providing fence guards, lights flags and temporary crossings for non vehicular traffic where ever required lift upto 5 ft (1.52m) and lead upto one chain (30.50m). (PHS#1, P# 60)	m^3	96.00			
12	Providing, Laying RCC Pipes of ASTM C-76-62 T/C-76-70 of Class II wall B and fixing in trench I/c , cutting , fitting and jointing with rubber ring i/c testing with water to specified pressure. (F) 24" dia (600mm). (PHSI# B-1, P#17)	m	40			
13	Refilling the excavated stuff in trenches 150mm thick layer I/c water ramming to full compaction etc complete (PHSI# 24, P# 77)	m^3	72.00			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Description	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
14	Stone Pitching hand packed with surface levelled off to the Correct Section with hammer dressed Stone and voids filled in 1:8 Cement mortar in floors of bridges and along hands and in aprons etc. including three chains lead. (GSI# 24, P# 32)	m^3	549.97			
15	Grouting stone pitching or apron in 1:3 cement mortar. (GSI# 12, P# 30)	m^2	3899.70			
16	Cost difference of Sulphate Resistant (SRC) cement and Ordinary Portland cement (OPC).	Per Bag	2657			
					CARRIED TO COLLECTION	

SIGNATURE OF CONTRACTOR

SEAL

MUNICIPAL SERVICES PROGRAM (MSP) JACOBABAD.

REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD CONTRACT PACKAGE AWW-01.

BILL OF QUANTITIES

Bill no.3: Rehabilitation& Strengthening of Existing Oxidation Ponds at Jani Dero.

S-No	Item	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
1	Excavation for tanks and reservoirs in slushy or daldally soils i/c trimmng and dressing sites to true alignment/design sections/profiles and shape levelling laying of earth in 150mm layer of construction of backs and dressing and disposal of surplus, excavated earth within one chain as directed by engineer incharge i/c providing fence guards, lights, flags were every required lift upto 5ft (1.52m) and lead upto 3 miles etc complete in alol respects as per drawings, Specifications and directions of Engineer..(PHESI#14, P#74)	m^3	13200			
2	Full hire charges of the pumping set per day inclusive of wage of driver and Assistant fuel or electric energy plate forms required for placing pumps etc. at lower depth with suction and delivery pipes for pumping out water found at various depths from trenches/tanks i/c the cost of erection and dismantling after completion of the job.(NSI)					
	ii) Hire charges of pumping set of upto 10 H.P pumping out water from upto 4.5meter deep tank/trench.	Per Day	180			
3	Excavation in foundation of building bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 1.52m. (b) In Ordinary soil. (GSI#18 (b), P#4)	m^3	12.00			
4	Cement concrete plain including placing compacting, finishing and curing, complete (including screening and washing of stone aggregates without shuttering) (I) Ratio 1:4:8 (GSI # 5(i), P# 16)	m^3	0.60			
5	Supplying and filling sand under floor and plugging in walls including watering and compaction. Lead upto 6 miles. (GSI# 29, P# 26)	m^3	1.20			
6	Coursed Rubble masonry including hammer dressing. (d) In cement sand mortar. (ii) Ratio 1:4 (GSI# 2, P#27)	m^3	73.80			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Item	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
7	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds: lifting shuttering curing rendering and finishing the exposed surface (including screening and washing of shingle). (a) R.C.C work in roof slab, beams columns rafts, lintels and other structural member laid in situ or precast laid in position complete in all respects. (ii) Ratio (1:1.5:3) GSI# #6 ii, P# 16)	m^3	6.60			
8	Fabrication of mild steel reinforcement for cement concrete including cutting, bending, laying in position , making joints and fastenings including cost of binding wire (also includes removal of rust from bars).(b) using Tor bars. (GSI # 8 b, P# 17).	Per Ton	0.70			
9	Earth work embankment from borrow pits including laying in 150mm layers, cold breaking ramming dressing complete, lead upto 6.0 miles & lift upto 1.52m. (In Ordinary soil) (HWSI#5, P#1).	m^3	4210.49			
10	Earth work Compaction by sheep foot roller and power roller with optimum moisture content (For 95-100% modified AASHO density (HWSI# 7a, P# 2)	m^3	4210.49			
11	Excavation for pipe lines in trenches and pits in soft soils I/c trimming and dressing sides to true alignment and shape leveling of beds of trenches to correct level and grade. Cutting joint holes and disposal of surplus earth within a one chain as directed by Engineer Incharge. providing fence guards, lights flags and temporary crossings for non vehicular traffic where ever required lift upto 5 ft (1.52m) and lead upto one chain (30.50m). (PHS#1, P# 60)	m^3	168.00			
12	Providing, Laying RCC Pipes of ASTM C-76-62 T/C-76-70 of Class II wall B and fixing in trench I/c , cutting , fitting and jointing with rubber ring i/c testing with water to specified pressure. (F) 24" dia (600mm). (PHSI# B-1, P#17)	m	70			
13	Refilling the excavated stuff in trenches 150mm thick layer I/c water ramming to full compaction etc complete (PHSI# 24, P# 77)	m^3	126.00			
14	Stone Pitching hand packed with surface levelled off to the Correct Section with hammer dressed Stone and voids filled in 1:8 Cement mortar in floors of bridges and along hands and in aprons etc. including three chains lead. (GSI# 24, P# 32)	m^3	252.63			

SIGNATURE OF CONTRACTOR

SEAL

S-No	Item	Unit	Quantity	Unit Rate		Amount in Rs.
	Schedule Items			**In Figure**	**In Words**	
15	Grouting stone pitching or apron in 1:3 cement mortar. (GSI# 12, P# 30)	m^2	2105.24			
16	Cost difference of Sulphate Resistant (SRC) cement and Ordinary Portland cement (OPC).	Per Bag	1579			
				CARRIED TO COLLECTION		

SIGNATURE OF CONTRACTOR

SEAL

MUNICIPAL SERVICES PROGRAM (MSP) JACOBABAD.

REHABILITATION/ STRENGTHENING OF EXISTING OXIDATION PONDS (ZONE-A, B & D) CONTRACT PACKAGE AWW-01.

BILL OF QUANTITIES

NO	PAGE NO	AMOUNT
	COLLECTION	
1	B.O.Q PAGE NO – 4	
2	B.O.Q PAGE NO – 7	
3	B.O.Q PAGE NO – 10	
	CARRIED TO SUMMARY TO BOQ PAGE No. 1	

SIGNATURE OF CONTRACTOR

SEAL

Project Management Unit (PMU)
Municipal Services Delivery Program (MSDP)
P&D Department, Government of Sindh

Sindh Municipal Services Program (MSP)

CONTRACT PACKAGE AWW-01

REHABILITATION/ STRENGTHENING OF EXISTING OXIDATION PONDS (ZONE A, B & D)AT JACOBABAD

BIDDING DOCUMENTS

VOLUME-II

TECHNICAL SPECIFICATIONS
&
TENDER DRAWINGS

APRIL, 2023

Issued to:_____ **Dated:**_____

Sindh MUNICIPAL SERVICES PROGRAM (MSP)
REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD
(Contact Package AWW-01)

TECHNICAL SPECIFICATIONS
List of Chapters

Sindh MUNICIPAL SERVICES PROGRAM (MSP)
REHABILITATION & STRENGTHENING OF EXISTING OXIDATION PONDS AT JACOBABAD

TECHNICAL SPECIFICATIONS
Table of Contents

1.0 GENERAL

1.1 Purpose and Location of the Works

Under the Municipal Services Program (MSP), funded by USAID, a project for enhancing water supply and development of complete distribution network for Jacobabad city is in the final stage of completion. Under this program the water supply to the city will be gradually enhanced up to 14 mgd by the year 2030.

Around 2/3rd of the consumed water is returned in shape of wastewater which requires proper collection, treatment and disposal system. It is estimated that with the addition of water supply to the city in the coming months around 7 MGD wastewater will be generated. However, the existing wastewater collection and treatment facilities are in a bad shape and not even capable of collecting and treating the current low sewage flows. In order to coup up with the abrupt increase in the wastewater generation it is imperative that a proper wastewater system is put in place else it will result in sewage overflows which will not only create unhygienic conditions in the city but may also cause contamination of water. Hence, to achieve this objective a comprehensive wastewater scheme for the city has been designed under MSP of USAID which includes construction of the collection network, auxiliary pumping stations and the up-gradation of the four zonal pumping stations.

For the purpose of planning and designing the wastewater scheme of the city has been divided into four zones named as zone A, B, C and D.

The zone-wise position of Oxidation Ponds is as under:

Zones	Pumping Station	Status	Location
A	Channa Mohalla	Existing	Aqilpur
B	Special Force Police Ground Pumping Station	Existing	Ahmed Pur
C	(i) Saddar Pumping Station (ii) Mauladad Pumping Station	To be constructed	Shambay Shah Road
D	Bolan Pumping Station	Existing	Deh Jani Daro

1.2 Description of the Works

The Works under the Contract comprises of:

- Rising main from Pump House to Oxidation ponds
- Pumping machinery for main pump house
- DG set
- Provision of SEPCO connection with transformer.

1.3 Standard Specifications

Plant, materials and workmanship shall comply with the requirements of British Standards and Codes of Practice current at the time of bid. Equivalent International Standards will be accepted by the Engineer provided their requirements are no less stringent.

The Contractor shall supply two copies of each ASTM, AASHTO, ACI, BS, EN and BSCP and other approved national or international standards which refer the specifications and other standards which apply to materials which are being supplied and workmanship which is being executed on the Works. One copy shall be available to the Engineer and other copy shall be kept by the Contractor on the site.

All materials and workmanship not covered by a ASTM, AASHTO, BS or BSCP or other approved standards shall be used in first class work and suitable for the climate in the area where the works are to be executed, for which Engineer's decision is a binding.

1.4 Drawings

Drawings which form part of the Contract are attached in this Volume.

1.5 Record Drawings

Within twenty-eight days of the issue of completion Certificate, the Contractor shall provide 6 copies and one reproducible of all updated drawings to comply with the works as built. These drawings shall include:

- General arrangement as built drawings of Pumping Machinery and allied structures, pipelines etc.

- Longitudinal sections of the sewers and rising main.

1.6 Materials and Suppliers of Materials

Before ordering materials of any description intended for the Permanent Works, the Contractor shall submit an approval form to Engineer including the names of the manufacturers / suppliers proposed, specifications of the materials and details of place of manufacture. The Contractor may be required to provide a copy of each order placed to Engineer for his retention.

1.7 Climatic Data

The Contractor shall take in account of the climatic conditions at the Site of the Works. The following information is provided as a guide to the climatic conditions likely to be encountered on the site to assist the Contractor, but this shall not relieve him of his responsibility under the Contract.

(1) Monthly average temperatures:
   a. Maximum 38 degree C
   b. Minimum 20 degree C

(2) Extreme Temperatures
   a. 50 degree C in May, June, July and August
   b. 1 degree C December and January

(3) Annual Average Rainfall

The recorded annual average rainfall is 192mm per year, whereas, the majority rain fall occurred during monsoon months of July and August. On average there are 10 rainy days per year but sometime rain fall intensities goes high up to 440mm for duration of 1 to 2 days.

The climatic data given above are based on limited records and their accuracy cannot therefore be guaranteed.

1.8 Other Works

(Deleted)

1.9 Programme

Before commencing the Works the Contractor shall submit to the Engineer for his approval a programme showing the order in which he proposes to carry out the Works. The programme shall be in the form of a bar chart, or any other form as may be agreed by the Engineer, and shall clearly indicate the following:

a. the sequence of each activity, the proposed start and completion dates of each activity, the rate of progress and the cumulative quantity or percentage of work expected to be achieved on each activity by the end of each month;

b. the time allocated for work by others, including those of the Employer and by utility undertakings;

The programme shall also include details of the following:

a. A statement giving the numbers and categories of supervisory and technical staff and skilled and unskilled workers to be employed on the Works.

b. A list and type details of major Constructional Plant (including vehicles) which the Contractor proposes to employ on the Works.

c. Details of the Contractor's methods of working for all operations.

d. A statement giving the proposals for location or locations and sizes of base camps, accommodation, offices, workshops and stores.

e. Details of the programme for the Works from the date of receipt of the Engineer's order to commence the Works including a complete resources allocation showing the number of units and allotted times for each unit of Constructional Plant, materials and labour allocated to each part of the works.

1.10 Notice of Operations

The Contractor shall give full and complete written notice of all important operations to the Engineer sufficiently in advance to enable the Engineer to make such arrangements as he may consider necessary for inspection or for any other purpose. The Contractor shall not commence any important operation without the written approval of the Engineer.

The Engineer's Site supervision staff shall be working 8 hours per day, Monday to Saturday. Expense incurred due to operations beyond above stated time frame which requires Engineer's staff supervision, shall be borne by the Contractor.

1.11 Temporary Works

Not less than fourteen days before commencing any portion of the Works, the Contractor shall, if ordered, submit to the Engineer for his approval complete drawings and calculations for all Temporary Works the Contractor may be proposing for the construction of that part of the Works.

Notwithstanding approval by the Engineer of any design for the Temporary Works, the Contractor shall be entirely responsible for their efficiency, security and maintenance and for all obligations and risks in regard to such Temporary Works specified or implied in the Contract.

1.12 Water and Electricity Supply

The Contractor shall at his own cost make arrangements for the supply of water and electricity for the purposes of the Works.

1.13 Disposal of Water

Water and wastewater derived from the construction, testing and completion of the Works shall be disposed of clear of the Site to the satisfaction of the Engineer so as to cause no damage or complaint.

1.14 Contractor's Facilities

The Contractor shall provide all site facilities including offices with telephone, workshops, stores, accommodation, washing, latrines etc. necessary for use by his own staff.

The Contractor shall be responsible for making all arrangements for drainage from his site facilities and shall be responsible for payment of all charges in connection therewith. Arrangements for the supply of electricity, water and gas shall be the responsibility of the Contractor.

Works Areas for the Contract in addition to those defined as Site of the Works shall be agreed with the Engineer.

1.15 Latrines

Throughout the period of construction of the Works the Contractor shall provide, maintain and cleanse suitable and sufficient latrines for use by his employees; he shall ensure that his employees do not foul the Site but make proper use of the latrines. Where practicable the latrines shall be connected to the nearest sewer, or if this is not practicable the Contractor shall provide an adequately sized septic tank and soak away.

1.16 Meetings and Reports

Representatives of the Contractor, approved by the Engineer, shall attend monthly progress meetings on Site or at the offices of the Employer/Engineer at any other place. In addition, approved representatives of the Contractor shall attend further meetings in cases of emergencies or for other reasons when called upon by the Employer/Engineer.

The Contractor shall submit to the Engineer each month a report on his progress on the performance of the Contract. The report shall include a copy of the approved programme with the current progress for each activity shown. No separate payment shall be made for this item.

1.17 Contract Signboard

The Contractor shall supply and erect one or more contract signboards at locations agreed by the Engineer. The signboards shall be of substantial construction to the approval of the Engineer and the lettering, in both English and Urdu shall be black on a yellow fluorescent background.

The layout and dimensions of the signboard shall be with the approval of the Engineer's Representative.

1.18 Level Datum

All levels stated shall be related to bench-marks located.

1.19 Contamination of Water Supplies

Deleted

1.20 Maintenance of Existing Access Track during the Works

On commencement of the Contract the Contractor shall be solely responsible for the maintenance of the existing access roads within the Site. This responsibility shall continue until the contract completion date, or until such earlier date as the Engineer may advise the Contractor in writing. In preparing his rate for maintenance of these access roads, the Contractor shall take into account that the access roads under his maintenance control will also be used by the Employer's and his staffs vehicles and also those of other contractors. Such maintenance work shall include general up keeping, and any necessary repairs to damaged road surfaces, pavement, drainage, associated slopes, etc (whether caused by the Contractor's activities or not) to a standard no worse than the original condition. During the carrying out of such maintenance work, the Contractor shall make arrangements to maintain through passage for the Employer's and his, staff's vehicles and also those of other contractors over these access roads, which may comprise temporary diversions all to the approval and satisfaction of the Engineer.

The Contractor shall not run tracked or unsprung vehicles on surfaced roads without the express approval of the Engineer who may require that planking or some other protective material be used to protect the road surface.

1.21 Existing Installations

The Contractor shall execute the Works in such a manner as to avoid interruption and interference with the operation of the existing water and sewerage conveyance system, treatment works, pumping stations and distribution systems and to minimize disturbance to the existing staff quarters and mosque adjacent to the Site. Access to the existing facilities shall be maintained, to the satisfaction of the Engineer, at all times.

The Contractor shall apply to the Engineer in writing at least 28 days before starting any work which involves interference with existing structures, equipment, etc or otherwise interfere with or interrupt the Employer's normal operation of the existing conveyance system, pumping and treatment works, and distribution system. The Contractor shall not execute such work until he has received permission to proceed, in writing from the Engineer.

The Contractor shall ensure that no earth, debris or rock is deposited on existing conduits, structures, public or private roads or rights of way as a result of the Works and all vehicles leaving the Site shall be cleaned accordingly.

The Contractor shall be responsible for the safety and security of existing services encountered during the course of execution of works and any damage to existing installation and services due to Contractor's operations shall be made good at his risk and cost. The Contractor shall gather the information of all services require protection and relocations, falls within the area of works, from SSGC, SEPCO, PTCL, TMA and any other agencies. The contractor shall strictly comply with the safety and precautions requirements as deemed necessary by the owner of the services.

1.22 Units of Measurement

All designs, specifications and manuals shall use SI (kg, m, sec) units and all measurements, dimensions and performance data shall be quoted in those units.

1.23 Languages

All drawings, instructions, signs, notices, name-plates etc. used during execution of works shall be in English. Warning signs shall be in Urdu and English.

1.24 Location of the Conduit within the reservation

(Deleted)

1.25 Advertising

The Contractor shall not use any part of the Site for any form of advertising without the prior written approval of the Engineer.

1.26 Site Investigation Records

The site investigation if deemed necessary by the Engineer, during the execution of the work shall be carried out by the Contractor at his own cost.

Before commencement of work at site the contractor shall carry out the trial pits up to the required formation level to locate any existing underground services and utility lines.

1.27 Safety and Environmental Regulations on Site

The Contractor shall comply with all statutory and other regulations concerning the safety of his site staff, operatives, staff of the Employer and Engineer and members of the public and protection of Environment, as a result of his operations. He shall obtain copies of all the relevant regulations, and shall make them available for inspection by the Engineer.

1.28 Other Works and Services

For all other works and services specified in the Specifications or shown on Drawings and for which there is no separate item in the Bill of Quantities, no payment shall be made directly and the cost thereof shall be deemed to be included in the unit rates of other items of BOQ.

1.29 Costs

The costs for complying with this section of specification shall not be paid separately and shall be included in the Contractor's rates and prices of the Bill of Quantities.

2.0 THE SITE

2.1 Site

The extent of the Site is defined in Specifications and the drawings. The Contractor shall not use the site for any purpose not required by the Contract.

The Site of the Oxidation Pond is located at Shambay Shah Road near Mauladad Railway Crossing.

2.2 Areas outside the Site

For the Contractor making use of any special or temporary way leave or additional accommodation acquired by him or any tip for the disposal of surplus materials he shall obtain the written consent of the owner, occupier or authority having charge of the land in which such way leave, accommodation or tip is situated and shall make a record agreed by the owner, occupier or authority as aforesaid of the condition of the surface of that land before entering thereon.

The Contractor shall permit the Employer and the Engineer and any person authorized by the Employer or the Engineer access for the purposes of the Contract to any such special or temporary way leave or additional accommodation.

In the event of the Contractor making use of any special or temporary wayleave or additional accommodation made available to him by the Employer for the purpose of the Contract, the land in which such way leave or accommodation is situated shall be deemed to be part of the Site as defined in Clause 2.1 hereof.

For the purposes of this Clause, 'accommodation' shall be deemed to include housing, offices, workshops, warehouses, storage areas and disposal areas.

2.3 Access to Site

The Contractor shall where necessary provide access to and through the site to adjacent properties as well as to other agencies/contractors who might be executing any development work for TMA, PMU or for any other agencies and coordinate his work with these agencies / contractors.

Before the commencement of any part of the Works, the Contractor shall make temporary access tracks including temporary diversions, approach roads, temporary roads in side river for movement of vehicles, transporting Pipe lines and other Construction material during execution of the work with approval of the Engineer. The Contractor shall maintain such access tracks in a condition suitable for the safe and easy passage of plant, vehicles and pedestrians required for the purpose of the Contract.

The Contractor shall make a record to be agreed by the Engineer of the condition of the surfaces of any private lands or of any public cultivated or maintained lands over which access to the Site lies before any work is commenced to make them suitable for access and he shall keep such surfaces in a reasonable state of cleanliness and repair during the execution of the Works. On the termination of the Contractor's use of such access he shall restore the surfaces to a condition at least equal to that existing before his first entry on them.

2.4 Clearance and Reinstatement of Site

The Contractor shall clear the Site of all vegetation, trees, hutments, obstructions etc. to the extent required by the Engineer for checking the setting out. The Contractor shall also ensure that the parts of the Site to be occupied by the Permanent Works are clear and maintain the remainder of the Site as may be required for access and Temporary Works areas.

The Contractor shall remove the material arising from such clearance and dispose off it in a manner and at a location, away from the site and inhabitant areas, no obstruction shall be cause to the existing traffic and adjacent properties and no excavated material shall be dumped or stock pile at site but removed directly to disposal areas identified by the Contractor, to the approval of the Engineer.

No heavy equipment/plant whether mobile or stationery shall be allowed to come nearer than 1.5 m of the existing sewage conveyance structures. For this purpose such structures and pipelines shall be protected by erecting warning fence or barricades.

The Contractor shall fill and make good with appropriate materials those cavities and losses of soil which result from clearing the parts of the Site not subsequently to be occupied by the Permanent Works.

The Contractor shall not clear the Site of any structure without the prior written permission of the Engineer.

2.5 Condition of Site

The Contractor shall maintain the Site in a neat, tidy and healthy condition for the whole of such time as he is responsible for the care of the Works.

2.6 Site Records

The Contractor shall make records of the position and extent in the excavations of every type of service, stratum and obstruction encountered during the construction of the Works.

2.7 Permits

The Contractor shall be fully responsible for obtaining necessary permits and permissions, except those normally obtained by the Employer or Engineer, prior to commencement of the Works.

2.8 Protection of Works against Flooding

The Contractor shall ensure the protection of all temporary and permanent works including plants, materials and equipment against flooding caused by sewage flow in river/nala as well as recurrent rains or any other reasons, during the course of execution of works. Before the commencement of works the Contractor will submit its detail work methodology, for Engineer's approval, showing manners to divert the existing flows in the river/nala away from the work area to be acquired in orderly state. The Contractor shall maintain such flow diversions in part or as a whole till the works have been completed or covered in accordance with drawings, specifications or as directed by the Engineer. The cost of complying with this section is deemed to be included in other items of BOQ, unless expressly specified otherwise.

2.9 Costs

The costs for complying with this section of specification shall not be paid separately and shall be deemed to be included in the Contractor's rates and prices of the Bill of Quantities.

3.0 MATERIALS AND WORKMANSHIP

3.1 Standard Specifications

Except where otherwise specified plant, materials and workmanship shall comply with the requirements of the relevant American Society for Testing and Materials, British Standards and Codes of Practice (hereinafter referred to as ASTM, BS or CP) issued by the British Standards Institution. Other equivalent National or International Standard Specifications may be substituted at the sole discretion of the ENGINEER or as may have been agreed in the Contract. All standards used will be the current version at the time of bidding.

The CONTRACTOR shall obtain at least one copy of each ASTM, BS, CP or other approved standard and reference work which is referred to in the Specification, and of each other standard which applies to materials which are being supplied to, or workmanship executed on, the Works. These standards and reference works shall be supplied to the ENGINEER within 60 days of the ENGINEER's order to commence the Works and will be available to the CONTRACTOR at all reasonable times.

All materials and workmanship not fully specified herein or covered by an approved standard shall be of such kind as is used in first class work and suitable to the climate in the project area, for which ENGINEER’s decision is a binding.

A list of standards and other publications referred to in the Specification is given in respective sections.

3.2 Suppliers of Materials

Before ordering material of any description intended for the Permanent Works, the CONTRACTOR shall submit for the approval of the ENGINEER the names of the maker or supplier proposed, a specification of the material and details of the place of origin or manufacture. If it is found necessary test regarding its compatibility with specifications be carried out at external facility. If requested by the ENGINEER the CONTRACTOR shall supply to the ENGINEER for his retention, a copy of any such order placed.

All materials used in the Permanent Works must be new, unless the use of old or refurbished material is expressly permitted by the Specification or the ENGINEER.

Materials used in the Works which are, or can be, in contact with the untreated or treated water shall not contain any matter which could impair taste, odour or toxicity or otherwise be harmful to health or adversely affect the water conveyed. Approval by bodies mentioned in Clause 1.06 will generally be regarded as satisfactory evidence of suitability.

3.3 Natural Materials

The CONTRACTOR shall make all arrangements for locating, selecting, and processing natural materials to comply with the Specification and shall submit to the ENGINEER for approval full information regarding the proposed location well in advance of commencement of working of the material. Approval of a location shall not imply that all material in that location is approved.

3.4 Sampling

The CONTRACTOR shall provide the ENGINEER with samples of materials necessary for testing in accordance with the Contract. Unless expressly excused the CONTRACTOR shall also provide samples of all manufactured items required for the Permanent Works, or alternatively the CONTRACTOR shall submit trade literature where the provision of samples, in the first instance, is impracticable.

All samples rejected by the ENGINEER shall be removed from Site. All approved samples shall be stored on Site by the CONTRACTOR for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation to the Permanent Works shall be of a quality at least equal to the approved sample.

3.5 Laboratory Facilities

The CONTRACTOR shall, for the duration of the Contract, supply maintain and operate a materials testing laboratory at site necessary for sampling, preparing and testing materials as specified. The CONTRACTOR may also use an off-site testing laboratory to perform

certain of the specified tests. Both the laboratory and the tests shall be to the approval of the ENGINEER, such approval shall not be given if significant delays in obtaining results are likely, or if the results may be unreliable. The CONTRACTOR shall make all the necessary arrangements and provide all transport and labour for conveying the samples to the approved laboratory, and shall ensure that any results are conveyed to the ENGINEER's Representative promptly. The ENGINEER's approval will be withdrawn if the service proves in any way unsatisfactory.

The CONTRACTOR shall provide trained and qualified Material Engineer, technicians and skilled labour to carryout specified tests to the satisfaction of the ENGINEER's representative. The Material Engineer and technicians shall be approved by the ENGINEER. In case of unsatisfactory performance such approval will be withdrawn and the CONTRACTOR shall arrange for suitable replacements for approval by the ENGINEER's representative.

The ENGINEER and his supervisory staff shall have access to the laboratory to supervise testing and to witness verification tests ordered by the ENGINEER or his staff.

The CONTRACTOR shall keep records of all tests he conducts in connection with compliance with, and as required by, the Specification, and shall supply copies of the results of such tests to the ENGINEER's Representative as soon as practicable after each test is made.

Notwithstanding the above the CONTRACTOR shall supply, maintain and operate all the necessary apparatus for certain tests which shall be carried out within the Permanent Works or elsewhere on the Site as directed by the ENGINEER; these tests are as follows:

Concrete Tests

(a)	Slump test	to ASTM C-143
(b)	Aggregate moisture test for determination of water/cement ratio	to ASTM C-566
(c)	Concrete cube crushing strength test	to ASTM C-39
(d)	Elongation and flakiness of aggregate	to BS 812: Part 1
(e)	Gradation of Aggregates	to ASTM C-136
(f)	Soundness of the aggregates	to ASTM C 88

The CONTRACTOR shall be responsible for making and curing test cylinders in accordance with ASTM C-31 and for measuring the temperature of atmosphere, formwork, concrete constituents and concrete itself as directed by the ENGINEER from time to time, and shall provide and maintain the equipment for so doing.

Soil Compaction Tests

(a)	Determination of the dry density/moisture Content relationship of soil	to AASHTO T-180
(b)	Determination of the dry Density of soil	to AASHTO T-191
(c)	Sand replacement test	to BS 1377
(d)	Determination of organic matter Content in soil	to BS 1377
(e)	Atterberg limit tests	to ASTM D 4318
(f)	Soil gradation analysis by mechanically vibrated sieves	to ASTM D 421
(g)	Soil gradation by Hydrometer (longstem type calibrated at 20^{o} C)	to ASTM D 422

(h)	Determination of sulphates content as SO_3	to BS 1377
(i)	Testing of water samples for electrical conductivity, soluble Cations and Anions, PH and dissolved solids etc.	to ASTM C 1602

In addition the following equipment will also be required:

- 1 Nr drying oven of a type approved by the ENGINEER and suitable for soil testing;
- 1 set Speedy Moisture Tester with balance and soil moisture absorbent, complete set in wooden case (for soil sample, 13 grammes);
- Spare Speedy Moisture absorbent, Calcium Carbide

3.6 Costs

The costs for complying with this section of specification shall not be paid separately and shall be deemed to be included in the CONTRACTOR's rates and prices of the Bill of Quantities.

4.0 EARTHWORKS

4.1 General

The CONTRACTOR shall make excavations and embankments up to required depth, by mechanical means or manual, and dispose off excavated materials all as specified here in, shown on Drawings or ordered by the ENGINEER and referred to herein as earthworks.

Except at paved road crossings, no heavy equipment shall be allowed on top of and within 1.5 m of the existing services, nor shall any material be allowed to be stored within this area. The CONTRACTOR shall exercise all care and take special measures to avoid any damage due to his operations to the existing services. Any harm to the existing services or development of any cracks from it shall be promptly notified to the ENGINEER and immediate control measures shall be taken to prevent loss of water and/ or aggravation of the damage. Necessary repairs shall be carried out as directed by the ENGINEER before proceeding further with the work. Before starting the excavation works, the CONTRACTOR shall arrange, provide and store at site materials and equipment which may be required to deal with any such emergency situation, in consultation with the ENGINEER.

Any damage caused to the existing services or structures due to CONTRACTOR's negligence shall be remedied and made good at no cost to the EMPLOYER.

4.2 Notice of Earthworks

Before commencing any earthworks on the Site, by machinery or manual work, the CONTRACTOR shall give the ENGINEER at least 7 days written notice of the proposed date, which shall not be less than 7 days after the appropriate part of the site has been cleared. Within this period the CONTRACTOR shall make a record of the ground levels and topography to the satisfaction of the ENGINEER for the measurement of the Works.

4.3 Ground Level

The actual ground levels will be recorded jointly with the ENGINEER after clearance of site as per Clause 2.4.

4.3.1 Disposal of excavated material

Any excavated material from previous construction work if disposed near or along the alignment of proposed mains shall be removed by the CONTRACTOR and shall be disposed of outside the limit of works as provided for in clause 4.16 hereof. Cost of this work shall be deemed to have been included in the quoted rates.

4.4 Excavation of Unsound Material

If any unsound material occurs in the bottom of any excavation, or on the foundation to an embankment, the CONTRACTOR shall remove it and dispose of it to the satisfaction of the ENGINEER. The CONTRACTOR shall fill the voids so formed with concrete Class 10/20 or suitable granular material as directed by the ENGINEER.

If the CONTRACTOR encounters material which to his opinion may be unsound, he shall immediately inform the ENGINEER, who will instruct the CONTRACTOR in writing as to whether the said material shall be treated as unsound, provided that the ENGINEER will give no such instruction except in accordance with Conditions of Contract. The omission by the ENGINEER to give an instruction shall not relieve the CONTRACTOR from any responsibility for defects in the work, if, prior to construction, the CONTRACTOR shall have failed to request the ENGINEER in writing to inspect the exposed foundation.

4.5 Safety of Excavation and Adjacent Structures

The CONTRACTOR shall provide support necessary to ensure the stability of the excavation and any existing underground services and utility lines.

Unless otherwise approved (e.g. when both foundations are in sound rock), where separate excavations are made to different depths for parts of the works close to each other, whether concurrently or not, then the foundation of the one shall be deepened and filled with concrete

Class “E” or the backfill to the other made with concrete Class “E”, whichever shall be constructed first, such that foundation pressure stress lines drawn at 40 degrees to the horizontal lie either entirely in undisturbed ground or in concrete Class “E” or better.

4.6 Slips, Falls and Excess Excavation

The CONTRACTOR shall prevent slips and falls of material from the sides of the excavation and embankments.

In the event of slips or falls occurring in the excavations, and where excavations are made in excess of the dimensions of the permanent works, the voids so formed shall be filled by the CONTRACTOR. When such voids, in the opinion of the ENGINEER, may affect the stability of the ground for the support of the works, or of the adjacent structures and services, the CONTRACTOR shall fill the void solid with concrete Class “E”. In other cases the CONTRACTOR shall fill the voids with selected excavated material placed and compacted to the approval of the ENGINEER. This shall be at no extra cost to the EMPLOYER.

CONTRACTOR shall exercise due diligence and care and shall ensure that excavation is precisely carried out to indicate trench levels.

Particular care shall be exercised by the CONTRACTOR to ensure that over excavation beyond specified levels is not carried out. In case of over excavation the volume excavated shall be replaced by Concrete of Class “E” at his cost. Filling of voids due to over excavation shall be in accordance with para 4.4 hereof.

4.7 Dewatering

The CONTRACTOR shall keep each structure and pipeline excavation clear of water during construction and, in the case of structures being constructed in saline groundwater for such further period as may be necessary to avoid the submersion of concrete within 3 days of its being placed. The method of keeping excavations clear of water, dewatering, and disposal of water, shall be subject to the approval of the ENGINEER The CONTRACTOR shall ensure that sufficient standby plant is on Site at all times to avoid any interruption in continuity of the dewatering. In the vicinity of the existing water mains and other structures, dewatering shall be carried out by establishing well points, lowering of the groundwater level to below the required excavation level and maintaining the same till the pipes are laid or the concrete is cast and is minimum 3 days old.

The well points for dewatering shall be located at safe distance from the foundation of existing pipe lines or other structures to avoid any settlement or other damage to the same.

The CONTRACTOR shall submit his dewatering plan with details of equipment, for approval of the ENGINEER minimum 15 days in advance of excavation work.

4.8 Preparation of Formations for Structures

All excavation within 600mm of existing structures shall be carried out very carefully by hand. Where the formation of any excavation, being other than rock, is to support the foundations or floor of a structure, a depth of 150 mm above the bottom of trench level, shall be carefully excavated and trimmed immediately before placing the permanent work upon it. Formation in granular material shall be compacted using suitable type compactors. Foundation of associated structures shall be compacted to 95% of the modified proctor density determined in accordance with AASHTO T-180 (D) while for other structures to the density of adjacent ground.

4.9 Backfill and Fill

Unless otherwise specified or approved the material used for backfill and fill shall be material selected from the excavated material of particle size not exceeding 100 mm.

Backfilling against the permanent work shall be selected, and free from boulders, cobbles, rock fragments and the like greater than 50 mm nominal size, unless otherwise specified or approved.

After approval has been given by the ENGINEER in accordance with the contract for filling or backfilling to commence, the operation shall start with the minimum delay and shall continue until the work is completed in the part of the Works for which the approval is given.

Unless otherwise specified, CONTRACTOR at all times must ensure that due to fill, backfill or for any other reason, the soil depth does not exceed 1 m over any existing conduit at any location.

4.10 Scarification

The CONTRACTOR shall scarify to a depth of 150 mm the ground upon which compaction of fill is specified. He shall ensure that no vegetation remains in the area to be covered by the Works, and shall if necessary bring the moisture content of the specified surface material to its optimum value before placing and compacting any fill thereon.

The CONTRACTOR shall similarly treat the surface of any fill which in the opinion of the ENGINEER has been exposed too long before the placing of subsequent fill thereon.

4.11 Compaction of Fill and Backfill

Unless otherwise specified or shown on the drawing, the CONTRACTOR shall deposit fill or backfill in layers of uniform depth not exceeding 150 mm thick and shall compact it by methods and with the use of such Constructional Plant as are necessary to achieve the degree of compaction specified. The layers shall have a slight cross-fall away from the permanent work. Where no degree of compaction is specified the fill or backfill shall be compacted by the even distribution over it of the passage of earthmoving plant and labour.

Where the degree of compaction is expressed as a percentage, it is the percent ratio of the dry density of the compacted material to the maximum dry density as determined by the modified compaction test (AASHTO T-180 Method D-modified). At least one month before commencing such compaction of the fill in the Works, the CONTRACTOR shall submit to the ENGINEER details of the method and Constructional Plant proposed to be used, and shall make such tests of the materials before and after compaction as the ENGINEER considers necessary, both of the trials and of the permanent work, to ascertain to his satisfaction that the degree of compaction specified is achieved. The modified compaction requirement will be 95% of Maximum Dry Density unless otherwise specified or shown on the drawing. All testing shall be in accordance with AASHTO T-191 and according to Modified Proctor Test.

The CONTRACTOR shall if necessary wet the fill material prior to and during compaction so that its moisture content lies within a range of values suitable for the fill material and the adopted method of compaction as may be established by prior trials on Site.

4.12 Hardcore Filling

Hardcore shall be clean, broken stone that will pass in all directions through a 100 mm ring. Hardcore shall be well packed and compacted to a CBR value of at least 25% as measured in accordance with AASHTO T-193. Sand may be added to hardcore to achieve this degree of compaction.

4.13 Allowance for Settlement

The CONTRACTOR shall make due allowance for consolidation and settlement of fill and compacted fill such that the levels and dimensions of the finished surfaces at the end of the Period of Maintenance are not less than those specified, shown on Drawings or ordered by the ENGINEER.

4.14 Location of Borrow Pits

The CONTRACTOR shall select and obtain permission of owner of sites of borrow Pits from outside the Site all subject to the written approval of the ENGINEER.

Borrow pits from these areas shall be subject to the written approval of the owner or concerned local authority.

4.15 Works at Borrow Pits

The CONTRACTOR shall excavate at the site of borrow pits to expose the material required for fill and shall select and excavate the said material. After the required amount of material has been excavated from each borrow pit, the CONTRACTOR shall reinstate its site by spreading the previously removed superficial materials in layers not exceeding 0.25 m deep over the area of the excavation and by grading and trimming the surfaces all to the satisfaction of the ENGINEER. Where practicable such grading shall be made to prevent accumulation of surface water.

The CONTRACTOR shall prepare and submit in detail for the approval of the ENGINEER his proposal for the use of borrow pits and shall give notice to the ENGINEER in writing at least one month before the proposed date of starting earthworks at the site of each borrow pit.

Where water table is encountered most of the material from borrow areas may have to be excavated from below the water table. The CONTRACTOR must include for this in his rates and allow suitable drainage periods before the material can be reworked to form embankments.

4.16 Disposal of Surplus Material

Surplus material will be disposed of away from site in surplus spoil dumps as directed by the ENGINEER. All surplus rock shall be disposed of to designate locations as directed by the ENGINEER, and be considered the property of the EMPLOYER. The CONTRACTOR shall prepare and submit his proposals for disposal of surplus excavated materials giving details of disposal sites and approximate quantities. The CONTRACTOR shall be responsible to obtain permission from owners of disposal sites and pay costs thereof.

4.17 Surplus Material Dumps

Unless otherwise approved, soil dumps shall on completion, be graded to slight cross falls and even side slopes, the maximum height of such dumps shall be 2 m.

4.18 Construction Methods

Laying of the water mains shall be carried out using only suitable excavation equipment of such types and in such numbers as is appropriate to a contract of the scale and complexity of this Contract, all subject to the approval of the ENGINEER. The heavy earthmoving equipment shall not be brought within a distance of 1.5 meter from the face of any existing conduit or other structure and no equipment shall be allowed over the roof of any existing conduit. Full details of the CONTRACTOR's proposed method of working and earth moving plant shall be provided in accordance with the instructions for bidding.

4.19 Excavation and Disposal

Material excavated for the construction of pipelines may be placed alongside for use in back fill. Excess material over and above that required shall be re used in other areas or disposed of in spoil embankments off site as directed by the ENGINEER and in accordance with Clause 4.16 above.

The CONTRACTOR shall prepare in advance a plan of earthworks operation for each particular part of the Works to be constructed at any one time, detailing the location and programme of excavation and of placing the spoil in banks etc. The CONTRACTOR shall submit his proposed plan at least 28 days before his intended date to commence earthworks on each particular part of the system for ENGINEER's approval.

Where a method of work is envisaged which will involve the longitudinal movement of excavated material along the pipe line alignment, movement shall be controlled with the use of mass haul diagrams. In such cases copies of these diagrams shall be included in the CONTRACTOR's plan of earthworks operation to be submitted to the ENGINEER in accordance with the above requirements.

4.20 Embankments

Embankments and ramps shall unless otherwise specified be formed from the material excavated from the site of the Permanent Works, if available. Where material for embankments is required additional to that available from such excavation, or where so specified, it shall be obtained from borrow areas under the terms of Clause 4.14.

The ENGINEER will maintain a random pattern of compaction testing to ensure that the CONTRACTOR is maintaining a working cycle which achieves the required compaction.

Embankments which carry un-surfaced roads shall be aligned and graded on the top surface by use of a motorized grader so as to permit the safe and easy passage of a light vehicle at a speed of 40km per hour and shall be maintained in this condition to the end of the Period of Contract.
The final finish of all un-surfaced roads shall be completed by use of a motorized grader.

4.21 Geomembrane

(Deleted) to be added

4.22 Rock

Before commencement of excavation in rock the CONTRACTOR shall demonstrate to the satisfaction of the ENGINEER his inability to excavate without resort to heavy percussion tools complete with rock bits, or hydraulic wedges. Where reasonable progress can be made with the aid of ripping tools the material will not be considered to be rock. The decision of the ENGINEER about the material to be excavated being rock or not shall be final & binding.

Use of jack hammers, and vibratory tools in proximity of existing structures shall not be allowed. No blasting is permitted within the limits of site.

Prior to the commencement of the excavation of any material which the CONTRACTOR considers may be rock, the CONTRACTOR shall advise the ENGINEER of the presence of such material and the said material shall not be classified as rock unless the ENGINEER has agreed to such classification before excavation commences. The ENGINEER's agreement shall be subject to reservations on the extent of the rock so classified and the extent of the rock excavation shall be determined after examination of the excavated faces. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the ENGINEER to enable the extent of the rock excavation to be determined.

4.23 Rubble and Loose Rock

Where stone pitching rip-rap or scour protection and rock fill vehicle barriers on existing conduit and structures are to be removed, the stones shall be stockpited outside the work area for later use in the same works. Additional quantities of stone and granular filter layer shall be provided by the CONTRACTOR to complete the work as shown on Drawings.

Where backfill or fill is shown as "rubble" or "loose rock", for example for soakaways from septic tanks, the material shall consist of durable gravel, broken stone or crushed concrete with a particle size not exceeding 100 mm. The grading of the material shall be such that there is no migration of fines into the fill and not more than 10% of material shall pass a BS sieve with 5 mm apertures.

The method of placing shall be to the approval of the ENGINEER and shall ensure that fines separating out during transportation are discarded or selectively placed.

There shall be no compaction or workings of the material except that necessary to give a stable fill.

Before covering rubble or loose rock with other fill the surface shall be blinded with a layer of selected fill that closes the surface voids only. The initial layer of covering fill shall not be watered.

4.24 Excavation by Blasting

In view of the alignment in proximity to inhabited areas, the excavation by blasting may not be permitted by the ENGINEER. In the event of the use of explosives is permitted, the safety of existing services and structures shall be guaranteed by the CONTRACTOR. The CONTRACTOR shall comply with the requirements, and give at least 48 hours notice of blasting to all relevant authorities and the ENGINEER.

The CONTRACTOR shall be solely responsible for obtaining a license to obtain, store & use of explosives.

However, excavation by blasting with explosives is not allowed nor any blasting within 20 m of any existing service(s) or any other structure.

4.25 Storage of Explosives

Explosives shall be stored in appropriate magazines clear of the Works. Detonators shall be stored separately from explosives. The CONTRACTOR shall appoint a responsible person to the approval of the ENGINEER and the Police Authorities, to be in charge of storing and issuing of explosives. The CONTRACTOR shall employ only experienced and responsible men to handle explosives for blasting purposes.

4.26 Earthwork: Measurement and Payments

All excavation and backfilling in Common Material or rock, to be paid for shall be the number of cubic meters of materials measured in its original position computed by average end-area method and excavated to the satisfaction of the ENGINEER. The pay line for structural excavation shall be as shown on drawings, having no side slopes.

Measurement for excavation shall not include material removed below the formation level and beyond specified pay-line, as described above or shown on drawings, as a result of anticipated swell, additional materials resulting from sliding, slips, caves-ins, silting or filling, whether due to the action of the elements or the carelessness of the CONTRACTOR.

No separate measurements for payment will be made inter alia for site clearance, removal of bush, trees etc. making records of ground levels and topography, supporting excavations, making good slips, falls and excess excavation, making benching for excavations in greater depth, working space beyond pay-line, trimming surface of excavations for structure and embankments (other than pavements), making allowance for settlements, special compaction trials, control of moisture contents, preparation and restoration of borrow pits, scarification, location and shaping of disposal heaps and embankments, trenches for pipes and cable within a structure, supplying samples and testing for the ENGINEER evaluation, interruptions and delays whilst carrying out tests.

The quantities determined shall be paid for at the contract unit price respectively for each of the particular pay item shown in the Bill of Quantities, which price and payment shall be the full compensation for all the costs involved in the proper completion of the work prescribed in that particular item.

4.27 References

Following publications have been referred:

1. AASHTO T-180: Standard Method of Test for Moisture-Density Relations of Soils
2. AASHTO T-191: Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
3. AASHTO T-193: Standard Method of Test for Determining California Bearing Ratio

5.0 CONCRETE & REINFORCEMENT

Design of the reinforced concrete structures has been carried out in accordance with ACI 315, ACI 318, ACI 350, UBC & ASCE (7-10). Construction of reinforced and water retaining structures is therefore to be carried out generally in accordance with the relevant provisions of ACI Code. The specific requirements made in this Chapter take precedence over those specified above.

5.1 Cement

5.1.1 General

Unless otherwise specified the cement used in the Superstructure Works shall be Ordinary Portland Cement (OPC) complying with ASTM C 150 (Type I) or BS 12 and whereas, in the Substructure Works, and where specified and/ or ordered, Sulphate Resisting Cement (SRC) complying with ASTM C 150 (Type V) or BS 4027, at the time of use. For the purpose of BS 12, the Site shall be deemed to be in a tropical climate. The CONTRACTOR shall supply the manufacturer's test certificate for each consignment of cement received at the Site as provided for in Section 15 of ASTM C 150 or Clause 10 of BS 12. He shall maintain a record available for inspection by the ENGINEER of the locations of concrete from each consignment.

Where specified or ordered sulphate resisting cement (SRC) complying with ASTM C 150 (Type V) or BS 4027, shall be used in place of OPC.

The CONTRACTOR shall supply samples of cement, when requested by the ENGINEER's Representative, both from any store on Site and the place of manufacture.

These specifications cover five types of Portland cement, as follows:

Table 5-1: Types of Portland cement.

No	Applicable Specifications		Application
	ASTM	BS	
a.	C150 (Type I)	BS 12	Ordinary Portland Cement: For use in general concrete construction when the special properties specified for Type II, III, IV and V are not required.
b.	C150 (Type II)	BS 1370	Moderate Heat Portland Cement: For use in general concrete construction exposed to moderate sulfate action, or when moderate heat of hydration is required.
c.	C150 (Type III)	BS 12	Rapid Hardening Portland Cement: For use when high early strength is required.
d.	C150 (Type IV)	BS 1370	Low Heat Portland Cement: For use when low heat of hydration is required.
e.	C150 (Type V)	BS 4027	Sulfate Resisting Portland Cement: For use when high sulfate resistance is required.

5.1.2 Packing and Marking

a. Cement shall be furnished in sacks or in bulk form, as approved by the Engineer.
b. Cement in sacks shall be delivered in strong, well made, paper or cloth bags, each plainly marked with the manufacturer's name, brand, type of cement and the weight of cement contained therein, except that, in the case of Type-I cement, the type need not be identified.
c. A bag shall contain 50 Kg. net.

d. When the cement is delivered in bulk; this information shall be contained in the shipping invoice, accompanying the shipment.

5.1.3 Inspection

The Contractor shall facilitate the Engineer, in all respects, for careful sampling and inspection, either at the mill or at the site of work, as may be specified by the Engineer. The following periods, in days, from the time of sampling shall be allowed for completion of testing.

a.	1-day test	6
b.	3-day test	8
c.	7-day test	12
d.	28-day test	33

5.1.4 Rejection

a. Cement may be rejected if it fails to meet any of the requirements of these specifications.
b. Cement remaining in bulk storage at the mill, prior to shipment, for a period greater than six months after completion to the tests, may be tested and may be rejected if it fails to conform to any of the requirements of these specifications.
c. Packages varying more than 3% from the weight marked thereon may be rejected and if the average weight of packages in any consignment as determined by weighing fifty packages taken at random, is less than that marked on the packages, the entire consignment may be rejected.
d. Packages received in broken or damaged condition shall be rejected or may be accepted only as fractional packages as determined by the Engineer.
e. Cement that is found to be adversely affected by moisture, as determined by the Engineer, shall be rejected.

5.1.5 Method of Sampling and Testing

a. The sampling and testing of Portland cement shall be in accordance with relevant BS or ASTM standard specifications.
b. Contractor shall carry out all tests on Portland cement, at his own cost, if required by the Engineer.

5.1.6 Transportation of Cement

Transportation of the cement from the mill to the site stores and to the point of use shall be accomplished in such a manner that the cement is completely protected from exposure to moisture.

5.1.7 Storage

a. Cement shall be stored in dry, weather tight and properly ventilated structures. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification of each consignment.
b. The sacks should be stacked closely on a damp proof floor or on timber planks, raised by a minimum of 12" (300 mm), from the ground, with air space below. There should be similar air space between the stacks and walls.
c. To avoid bursting of bags and setting under pressure, the height of the stacks shall be limited 8 bags.
d. Adequate storage capacity shall be furnished to provide sufficient cement to meet the peak needs of the project.
e. Cement storage facilities shall be emptied and cleaned by the Contractor when so directed, however, the interval between required cleaning normally will not be less than four months.

5.1.8 Usage

a. The Contractor shall use cement in the approximate chronological order in which it is received at the site. All empty sacks shall be promptly disposed off as approved by the Engineer.

b. No cement stored through a monsoon, or for a period of more than six months, should be used, unless tests have been applied and cement found up to the requisite standard.
c. Suitable, accurate scales shall be provided by the Contractor for weighing the cement in stores and elsewhere on the work, if required, and he shall also furnish all necessary test weights.

5.1.9 Delivery and Usage Record:

Accurate records of delivery of cement and its use in the works shall be kept by the Contractor. Copies of these records shall be supplied to the Engineer in such a form as he may require.

5.2 Aggregates

Aggregates for concrete shall comply with ASTM C-33, Specification for
Concrete Aggregates.
Fine aggregate shall consist of natural sand. The Contractor shall obtain concrete aggregate from deposits of natural sand and gravel or shall procure crushed aggregate from approved quarries, which produce aggregates meeting with the Specifications contained herein. The ENGINEER will permit the addition of suitable crushed rock fine aggregate, as necessary, to the sand where in his opinion it is impracticable to obtain the specified grading of the combined aggregate, otherwise than by such addition. The maximum quantities of clay, silt and Fine dust shall, in any event, not exceed 3 % by weight when tested in accordance with ASTM C-117. Fineness modulus shall range between 1.9 and 2.78. The sand equivalent value, as determined by ASTM Designation D 2419, "Standard Test Method for Sand Equivalence Value of Soils and Fine Aggregate", shall not be less than 75.

The grading of fine aggregate shall conform to the following requirements:

Table 5-2: Grading requirement of Fine aggregate.

U.S. Standard Sieve Mesh	Percent Passing
0.375" (9.50 mm)	100
No.4 (4.75 mm)	95-100
No.8 (2.37 mm)	80-100
No.16 (1.18 mm)	50-85
No.30 (0.60 mm)	25-60
No.50 (0.30 mm)	5-30
No.100 (0.15 mm)	0-10

The grading of the coarse aggregate, within the separated size groups, shall conform to the following requirements:

Table 5-3: Grading requirement of the coarse aggregate.

US Standard Sieve Size (Nominal Size)	Percent Passing by Weight Finer than Each Laboratory Sieve (Single Size Aggregate)			
	10 mm	20 mm	25 mm	40 mm
2.00" (50.00 mm)	-	-	-	100
1.50" (37.50 mm)	-	-	100	90-100
1.00" (25.00 mm)	-	100	90-100	20-55
0.75" (19.00 mm)	-	90-100	20-55	0-15
0.50" (12.50 mm)	100	20-55	0-10	-
0.375" (9.50 mm)	85-100	0-15	0-5	0-5
No. 4 (4.75 mm)	10-30	0-5	-	-
No. 8 (2.37 mm)	0-10	-	-	-
No. 16 (1.18 mm)	0-5	-	-	-

5.2.1 Coarse Aggregate Shape:

a. A flat particle is one having a ratio of width to thickness greater than three. An elongated particle is one having a ratio of length to width greater than three.
b. The shape of the particles shall generally be spherical or cubical.
c. The quantity of flat and elongated particles, in the separated size groups of coarse aggregate, as defined and determined by standard tests, approved by the Engineer, shall not exceed 15% by weight in any size group.

The 10% fine value shall be greater than 50 kN.

The aggregates shall be such that concrete when made and tested in accordance with Building Research Establishment Digest 35 (2nd series) shall not show a drying shrinkage greater than 0.065%.

The water absorption of aggregates to be used for Class A concrete shall not exceed 3 %.

The soundness of the aggregate, as determined in accordance with ASTM C 88 using magnesium sulphate with 5 cycles, shall not show a loss of greater than 15% for fine aggregate and 18% for coarse aggregate.

Immediately after commencement of the Works, the CONTRACTOR shall supply samples of proposed aggregates for preliminary tests of compliance with the Specification to the satisfaction of the ENGINEER before the ENGINEER will give approval to the source of aggregates proposed by the CONTRACTOR. Alternatively, and subject to the approval of the circumstances by the ENGINEER, the CONTRACTOR may submit a Certificate from an independent laboratory acceptable to the ENGINEER.

Where 40 mm nominal maximum size coarse aggregate is specified it shall consist of a mix of 40 mm single sized aggregate, 20 mm single sized aggregate and 10 mm single sized aggregate.

During the performance of the Contract, the CONTRACTOR shall supply samples of aggregates when required by the ENGINEER for testing. Testing of all specified requirements will be performed weekly for each source at each grading approved by the ENGINEER, unless otherwise instructed by the ENGINEER.

Any rejected aggregate shall be removed from Site within 3 days.

To determine the potential reactivity of the aggregate and the cement aggregate combinations, the CONTRACTOR shall carry out tests in accordance with ASTM C 227 and ASTM C 289.

Should the results of the tests prove unsatisfactory the CONTRACTOR shall make provision for the employment of a low alkali content cement to the approval of the ENGINEER.

5.2.2 Storage

a. Aggregate shall be stored, at the site, in such a manner as to prevent its deterioration or the inclusion of foreign matter.
b. Aggregate, which has deteriorated or which has been contaminated, shall not be used for concrete.
c. All methods employed by the Contractor for loading, unloading, handling and stock-piling aggregates shall be subject to the approval of the Engineer, at all times.
d. Sufficient aggregate shall be maintained at the site, at all times, to assure continuous placement and completion of any lift of concrete started.

5.3 Water

The water used for making and curing concrete shall generally be of drinking water quality and shall be from a source approved by the ENGINEER and at the time of use shall be free from polluting matter in any quantity which:

a) affects the initial setting time of the cement by more than 30 minutes or reduces the compressive strength of test cubes by more than 20%.
b) prevents the achievement of the specified test cube strengths at 28 days for the appropriate class of concrete.
c) produces discoloration or efflorescence on the surface of the hardened concrete.

The water shall conform to the requirements of ASTM C1602, as to its suitability, for construction. The water shall be free from hydrocarbons and from suspended organic matter. Inorganic matter in solution shall not exceed 500 mg/I by weight and in suspension shall not exceed 50 mg/I by weight.

The water which the CONTRACTOR proposes shall be tested to the approval of the ENGINEER before use in the permanent works.

Regular tests of the water shall be made during construction of the Works. The water shall be sampled at the point of discharge into the mix and the frequency of sampling shall be as approved by the ENGINEER. The CONTRACTOR shall supply two copies of each test result to ENGINEER's Representative.

5.4 Admixtures

Concrete shall be made from cement, aggregates and water as specified. No other ingredient shall be mixed with the concrete or mortar without the ENGINEER's approval.

If the CONTRACTOR proposes to use retarding or workability agents in accordance with ASTM C-494, then the manufacturer's literature must be supplied giving typical dosage, effects of incorrect dosage, the amount of air entrainment associated with its use. The ENGINEER's approval to the use of admixtures shall be subject to the following conditions:

a) Under no circumstances calcium chloride or chloride based admixtures be used in any concrete mix, grout or mortar.
b) No reduction of target mean strength compared with additive-free concrete of the same class.
c) No change in specified cement or effective water cement ratio.
d) No corrosive effect on reinforcement steel.
e) Dosage and admixture strictly in accordance with the manufacturer's instruction in respect of the specific conditions obtaining. Dosage to be by approved dispenser, to within 3% of the required amount.

If air entrainment is approved the air content shall be 4% for concrete with a maximum aggregate size of 40mm and 5% of concrete with maximum aggregate size of 20mm, an allowable tolerance of $\pm$ 1.5%.
The method of determining the air content shall be in accordance with ASTM C-231 and the CONTRACTOR shall supply the necessary apparatus so that the ENGINEER may check the air content. If the average air content is greater or less than that specified or the range is greater than 2%, before any further concrete is used in the Works the CONTRACTOR shall take such steps as may be agreed with the ENGINEER to adjust the air content of the concrete or improve its uniformity.

5.5 Chemicals in Concrete Materials

The total sulphate content, whether as gypsum or more soluble salts, of concrete ingredients when measured as sulphur trioxide shall together not exceed 4.0% of the weight of cement in the concrete.

The chloride content of concrete ingredients when measured as CI shall together not exceed 0.3 % of the weight of cement in concrete using OPC cement and 0.06% of the weight of cement in concrete using SRC.

The sulphate and chloride contents shall be established using the following tests:

Table 5-4: Tests for establishing sulphate and chloride content.

	Sulphate	Chloride
Aggregate	BS 1377, Test 9	ASTM C-1524
Cement	ASTM C-114	ASTM C-114
Water	ASTM D-516	ASTM D-512

The contribution of any admixture must also be included. Testing will be weekly, or as directed by the ENGINEER. When the acid soluble alkali content of the cement is greater than 0.6% (calculated as $Na_2O + 0.658\ K_2O$) the CONTRACTOR must demonstrate that no adverse alkali-silica reaction is likely. Any concrete containing less than 3.0 kg/m^3 may be considered not at risk. In the event of higher alkali contents a sample of aggregate from each source must be tested in accordance with ASTM C 227. Any aggregate source showing an expansion greater than 0.05% at 3 months shall not be approved.

5.6 Reinforcement

Reinforcement shall be Type 2 deformed bars, either hot rolled high yield steel to ASTM A-615 or cold worked steel to BS 4449.

The CONTRACTOR shall supply the ENGINEER's Representative with certificates of the manufacturer issued in accordance with relevant international standards, for all the required tests including the re-bend test in respect of each consignment delivered to Site.

Steel fabric reinforcement shall comply with BS 4483.

The reinforcement at the time of incorporation in the Permanent Works shall be clean and free from damage, oil or grease, loose mill scale and loose rust. Bars which have become bent shall not be straightened or reheat for incorporation in the Works without the approval of the ENGINEER.

Steel reinforcement shall be stored clear of the ground and supported to prevent distortion. The Contractor shall provide all measuring and testing facilities to ascertain quality, weight and quantity of steel, at his own expense, if so directed by the Engineer, in presence of ENGINEER’s Representative at a laboratory approved by the ENGINEER.

5.7 Reinforcement Details

The CONTRACTOR shall ascertain for himself from the information given on the Drawings and in the Specification the precise requirements of steel reinforcement to be obtained for the Permanent Works. The CONTRACTOR shall prepare bending schedules and submit them to the ENGINEER at least 28 days prior to fixing the respective reinforcement.

All concrete other than that described on the Drawings or in the Bill of Quantities as mass, blinding or screed, shall be assumed to be reinforced.

5.8 Waterstops

Where specified on the Drawings, the Contractor shall supply and fix waterstops to all expansion, contraction and construction joints where shown on the Drawings and as directed by the Engineer. These shall be installed in accordance with the manufacturer’s recommendations and shall be continuous.

The number of joints made, on Site shall be kept to a minimum. Any jointing of PVC waterstops on Site shall be by the process of heat fusion using an appropriate jig and heating blade all in accordance with the manufacturer's recommendations.

The minimum dimensions of water-stops shall be as tabulated below (all dimensions in mm):

Table 5-5: Minimum dimensions of water-stops.

Width Thickness	Web diameter	Edge bulb* int. diameter	Centre bulb* height	Edge bulb**
250	4.5	12.5	8	-
250	4.5	12.5	8	-
250	4.5	19	10	22

Notes: * Internal waterstop only
** External waterstops only

Unless otherwise shown on the Drawings, the width of the waterstop shall be at least equal to the thickness of the concrete member to which it is embedded, up to a maximum width of 250 mm.

The edge bulb section of internal waterstops shall be circular or semicircular. The centre bulb should be hollow or as directed by the Engineer.

The waterstop shall be carefully maintained in the position shown on the Drawings and properly protected from damage and the harmful effects of light and heat during all stages of construction. The stop-boards on each side of the waterstop shall be accurately brought to match the profile of the waterstop. The concrete shall be carefully compacted under and around the waterstop so as to leave no cavities.

The Contractor shall supply the manufacturer's test certificates for each consignment of waterstop delivered to Site and shall if requested supply to the Engineer sufficient samples of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate standard test procedure.

The PVC for PVC waterstop shall be high grade virgin polyvinyl chloride containing no filler, reclaimed or scrap material. It shall comply with following requirements:

Table 5-6: Test Requirements for PVC Waterstops.

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi (13.78 Mpa) min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F (-37o C)
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 ±3

5.9 Joint Filler

The CONTRACTOR shall supply and fix premoulded joint fillers in all expansion joints and where shown on the Drawings. Unless otherwise specified the joint filler shall be of resin or bitumen bonded cork or impregnated fiberboard. Impregnated fiberboard shall not be used in water retaining structures. Material shall be obtained from manufacturers approved by the

ENGINEER and shall be stored and fixed in accordance with the manufacturer's instructions. The joint filler of the material and thickness specified shall be cut to shape and fixed to fill the whole space between the concrete faces to the joint not otherwise filled by waterstop and joint sealer. Abutting pieces shall be placed in close contact and the joints covered on each side to prevent the passage of cement grout.

The CONTRACTOR shall supply the manufacturer's test certificate for each consignment of each type of joint filler delivered to Site and shall supply to the ENGINEER sufficient samples of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate standard test procedure.

The filler shall comply with the following American Society for Testing and Materials Specification:

1. Resin Bonded Cork — ASTM D 1752 Type II
2. Bitumen Bonded Cork and Impregnated Fiberboard — ASTM D 1751

5.10 Joint Sealer

The CONTRACTOR shall construct recesses at all joints, and on both faces of the concrete work, except on the underside of ground slabs. The recesses shall be accurately formed to the lines and dimensions shown on the Drawings or as agreed with the ENGINEER.

The CONTRACTOR shall prepare the surfaces of the recess and shall supply a joint sealer and fill or caulk the recess completely with it.

Joint sealing shall not be commenced without the approval of the ENGINEER. In reservoir joints the sealer shall be poured after the construction of the reservoir roof.

All joint sealers shall be from an approved manufacturer. The CONTRACTOR shall supply the manufacturer's test certificates for each consignment of each type of joint sealant delivered to the Site and shall if requested supply to the ENGINEER sufficient samples of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate test procedure.

Sealants shall be installed in strict accordance with the manufacturer's instructions. De-bonding strip shall be used in conjunction with the sealers as indicated on the Drawings. The de-bonding strip shall be compatible with the joint sealer and shall be resistant to attack from the primer used to bond the sealer to the concrete.

All sealers shall be appropriate for the prevailing climatic conditions.

Polysulphide and polyurethane sealers shall not abut bituminous sealers. Surfaces to receive polysulphide and polyurethane sealers shall be kept free from bituminous paints.

5.11 Sealant Types

5.11.1 Bituminous Sealer

Bituminous sealers shall comply with BS 2499 for Type A1.

Bituminous sealer shall be obtained from manufacturers approved by the Engineer and shall be appropriate for the prevailing climatic conditions.

The hot poured rubber/bitumen compound for sealing horizontal joints shall comply with BS 2499 for Type AI. For sloping, vertical and soffit joints a bituminous putty shall be supplied which shall not slump in a vertical joint 25 mm wide and 25 mm deep at a temperature of 80°C.

5.11.2 Polysulphide Sealer

Polysulphide sealer shall comply with BS EN ISO 11600:2003. It shall be obtained from manufacturers approved by the Engineer and shall be appropriate for the prevailing climatic conditions.

In conjunction with this type of sealer an approved bond breaker such as a self-adhesive polythene strip shall be positioned against the exposed edge of the joint filler prior to application of the joint sealer. The bond breaker shall be resistant to attack from any primer used to bond the polysulphide sealer to the concrete.

5.11.3 Polyurethane Sealer

Polyurethane joint sealer shall meet the performance requirements of U.S Federal Specifications TT-S-00277E, Type II Class A or as approved by the Engineer and shall be compatible for use in specific works limitation.

Its usage shall strictly be in accordance with manufacturer's recommendations.

5.12 Bituminous Paint

Bituminous paint shall comply with BS 3416, Type 11 for materials in contact with raw or treated water and Type I for all other cases.

Prior to application of the bituminous paint the concrete faces must be clean and dry. A minimum of two coats of paint shall be applied and each coating shall be a dry film mass of 35 ±5 g/m= after 48 hours drying.

5.13 Bond Breaking Compound

Bond breaking compound shall consist of 66% of 200 pen bitumen blend hot with 14 light creosote oil and, when cold brought to the consistency of paint by the addition of 20 % solvent naphtha or other approved compound meeting the following requirements:

a) It shall not retard or in any other way affect the setting of concrete.

b) The average bond stress on bars coated with the compound with half their length cast into concrete specimens and subjected to pull out tests at 7 days shall not exceed 0.13 N/mm' and the total movement of the dowel bar relative to the concrete specimens shall be not less than 0.15 mm at that stress. The concrete specimens shall be 150 mm x 150 mm in section and 450 mm long and made with the same mix proportion as used in the Works.

5.14 Slip Membrane for Sliding Joints

Slip membrane material used for sliding joints shall consist of two thicknesses of low friction plastic material which shall be non-toxic and suitable for use with potable water, compatible with any other materials used in conjunction with them, non-extruding and durable. The coefficient of friction between the two strips shall not exceed 0.20 when subjected to a load of 220 kN/m^2. The maximum bearing pressure for the material shall not be less than 250 kN/ m^2.

The lower layer shall be self-adhesive and the concrete surface to which this is fixed shall be smooth, clean and free from dust and be finished with a steel or wood float to provide a smooth true surface.

5.15 Classes of Concrete

The class of concrete is defined by the characteristic cube crushing strength and the nominal maximum aggregate size, with additional suffix defining any additional requirements. The requirements for each class of concrete are given in Table 5-8.

The main classes of concrete used will be as follows:

Table 5-7: Main classes of concrete.

Location	Class
Structural	A
Structural	A (1)
Structural / Plain Concrete	B
Structural / Plain Concrete	B (1)
Blinding Concrete	E
Blinding Concrete	E (1)

Table 5-8: The requirements for each class of concrete.

Concrete class	Maximum Aggregate Size (mm)	Cement type	Workability*
Class “A”	20	OPC	Medium / High
Class “A (1)”	20	SRC	Medium / High
Class “B”	20	OPC	Medium
Class “B (1)”	20	SRC	Medium
Class “E”	20	OPC	-
Class “E (1)”	20	SRC	-

Note: - *High workability: slump 65 to 135 mm
Medium workability: slump 50 to 100 mm

Quoted slump values are a guide only and may be varied subject to the approval of the ENGINEER.

The concrete class is defined as the 28 day cube crushing strength (psi) below which no more than 5% of results are expected to fall.

Except where otherwise specified herein, the mix design, concrete ingredients, manufacture, testing and workmanship shall conform to the requirements of relevant sections of ACI & ASTM.

Adjustments to the concrete mix proportions shall be made during the contract if in the opinion of the ENGINEER, such adjustments are necessary. The CONTRACTOR shall neither alter the mix proportions nor the source of supply of any of the ingredients without prior approval of the ENGINEER.

5.16 Concrete Mix Design

The CONTRACTOR shall determine to the approval of the ENGINEER the actual proportions of ingredients for each class of concrete to be used to the Permanent Works.

The concrete shall meet the requirements given in Table 5-9.

Table 5-9: Requirements of Classes of Concrete.

Class	Cement content (kg/m^3)		Maximum W/C ratio	Cylinder Crushing Strengths Kg/cm^2 (Psi)	
	Minimum	Maximum		Design	Working
Class “A”	360	440	0.50	386 (5500)	316 (4500)
Class “A(1)”	420	460	0.48	386 (5500)	316 (4500)
Class “B”	300	380	0.58	275 (3900)	225 (3200)
Class “B (1)”	320	400	0.52	275 (3900)	225 (3200)
Class “E”	240	-	0.70	140 (2000)	123 (1750)
Class “E(1)”	300	-	0.70	140 (2000)	123 (1750)

Water/cement (W/C) ratio is the ratio of weight of free water to cement in the mix based on aggregates being in a saturated surface dry condition.

Unless otherwise specified or agreed by the ENGINEER for concrete Class “A” & “A(1)” the proportions of coarse and fine aggregates shall be selected to achieve one of the grading curves defined in Table 5-10, within an allowable tolerance of generally 5%. A change from a maximum positive tolerance to a maximum negative tolerance in consecutive sieve sizes should be avoided.

The CONTRACTOR shall submit details of the source of all material and the proposed quantities of each ingredient per cubic meter of fully compacted concrete. The CONTRACTOR shall then make trial mixes for each class of concrete using the same type of Constructional Plant and the same materials as are proposed for the Permanent Works.

The CONTRACTOR shall give 24 hours notice of such trials to enable the ENGINEER's Representative to attend. For each trial mix, three separate batches of concrete shall be made by the CONTRACTOR and will be tested at 28 days all in accordance with BS 1881. Such trial mixes shall not be the first batch through the plant in any one sequence of concrete production.

The CONTRACTOR shall not commence concreting in the Permanent Works until details of trial mixes and test results for each class of concrete have been submitted to, and approved by, the ENGINEER.

A trial mix design will be approved by the ENGINEER with respect to strength if the average compressive strength of the nine cubes so tested is more than the design strength appropriate to the class as given in Table 5-9.

For concrete Class "A" & "A(1)", the CONTRACTOR shall cast sample wall panels in two phases. In the first, three different mixes from adjacent aggregate grading curve zones shall be cast into wall panels. When the CONTRACTOR has demonstrated that the mix from the middle of the three grading zones is the most practical mix he shall proceed with phase two on the basis of this preferred mix. In the second phase two batches, mixed 48 hours apart, utilizing the preferred mix, shall be cast in two equal lifts to form a wall panel having one horizontal construction joint formed to the manner proposed by the CONTRACTOR for the Works. The top surface of the second lift shall have a Type U3 finish. The panels shall not be touched up after stripping.

The panels shall be 300 mm thick and 1.5 m long by 1.5 m high. The CONTRACTOR shall not commence concreting to the Permanent Works until the test panels have been approved by the ENGINEER.

The CONTRACTOR shall not alter the approved mix proportions nor the approved source of supply of any of the ingredients without having previously obtained the approval of the ENGINEER.

During production the ENGINEER may require trial mixes to be made before a substantial change is made to the materials or in the proportions of the materials to be used.

5.16.1 Concrete Exposed to Sulphate Attack

Before commencing any concreting on Site the CONTRACTOR shall conduct tests to the satisfaction of the ENGINEER to determine the concentration of sulphate in the soil and groundwater in order to determine the concrete exposure class.

The CONTRACTOR shall ensure that all concrete susceptible to sulphate attack shall be designed to satisfy the additional requirements for the particular exposure class. This shall be taken to include all concrete from below finished ground level up to 1.0m above finished ground level.

SRPC cement shall be used for following concentration of sulphates in soil and ground water if approved by the ENGINEER.

a) In soil : 0.2% or more
b) In groundwater : 0.3 g/l or more
c) In 2:1 water
Soil extract : 1.0 g/l or more

Table 5-10: Combined Aggregate Gradings:
a) 40 mm maximum aggregate size grading curves

Sieve size (mm)	1	2	3	4
50	100	100	100	100
37.5	95	97	99	100
20	50	59	67	75
10	36	44	52	60
5	24	32	40	47
2.36	18	25	31	38
1.18	12	18	24	30
0.60	7	12	17	23
0.30	3	7	11	15
0.15	0	0	2	5

b) 20 mm maximum aggregate size grading curves

Sieve size (mm)	1	2	3	4
37.5	100	100	100	100
20	95	97	99	100
10	45	55	65	75
5	30	35	42	48
2.36	23	28	35	42
1.18	16	21	28	34
0.60	9	14	21	27
0.30	2	3	5	12
0.15	0	0	0	1.5

c) 10 mm maximum aggregate size grading curves

Sieve size (mm)	1	2	3	4
10	95	97	99	100
5	30	45	60	75
2.36	20	33	46	60
1.18	16	26	37	46
0.60	12	19	28	34
0.30	4	8	14	20
0.15	0	1	3	6

5.17 Storage of Materials

The CONTRACTOR's arrangements for storing and handling the materials for concrete shall be to the approval of the ENGINEER. Such arrangements shall be directed towards preventing the deterioration or adulteration of the various materials or segregation of the ingredients thereof.

5.18 Control and Mixing of Ingredients

The CONTRACTOR shall measure the moisture content in the aggregates and so determine the amount of water to be added to each batch of fresh concrete. Such determinations shall be to the approval of the ENGINEER and the results and calculations shall be available for inspection by him. The frequency of such determinations shall be as directed by the ENGINEER and shall depend on the quality of control of storage and handling, weather conditions and variability of aggregate supplied.

The CONTRACTOR shall proportion the ingredients of each batch of concrete by weight. The measuring equipment should give an accuracy of ±3% for each ingredient. The water

shall be added to the aggregates and cement in a mechanical batch mixer; it shall not exceed the maximum ratio with regard to cement given in Table 5-9 hereof, and shall otherwise be the minimum amount necessary consistent orb complete compaction The device for measuring the water shall show accurately the weight required with a given moisture content of the aggregate and shall be so designed that the water supply will be automatically stopped when the correct quantity has been discharged into the mix. The concrete ingredients shall then be thoroughly mixed.

The minimum mixing time shall be:

(i) For mixes of 1.5 m^3 Capacity or less -1½ minutes.

(ii) For mixes of larger capacity than 1.5 m3 the time shall be increased by 15 seconds for each additional 0.75 m3 capacity. For intermediate sizes the time shall be assessed by proportion.

In special circumstances, for quantities not exceeding one cubic meter and at the sole discretion of the ENGINEER, the proportioning of materials by volume may be approved. In such circumstances the cement content of the concrete shall be increased by 10% over the amount in the approved mix. The boxes used for proportioning shall be deep and narrow to the approval of the ENGINEER, and shall be separately constructed for each class of concrete to be proportioned by volume.

5.19 Concrete Sampling and Testing

The temperature of concrete, concrete constituents, reinforcement formwork and the atmosphere shall be monitored continuously for every concrete pour. All sampling and testing of fresh and of hardened concrete shall be carried out in accordance with the relevant provision of ASTM or equivalent international standard unless such provision is at variance with the Specification.

Table 5-11 gives the programme for sampling and testing of concrete for each class of concrete from each batching centre in each active day.

The CONTRACTOR shall establish a plan for sampling and testing to the approval of the ENGINEER. Samples shall be taken at the place of deposition from each class of concrete at random. The frequency of sampling shall in general be in accordance with Table 5-11, but the actual rate of sampling may vary with the approval of the ENGINEER and shall be increased when ordered by the ENGINEER in appropriate circumstances. From each such sample three test cylinders shall be prepared; each cylinder shall be marked indelibly for identification when it is in the mould. After retention at the site for 24 hours the cylinder shall be delivered to the testing laboratory for curing and testing.

Table 5-11: Programme for Works Sampling and Testing.

	Class "A" & "A(1)"	Class "E" & "E(1)"
Workability (slump test)	1	0
Workability (compacting factor test)	2	0
Compressive strength	2	3

Where:

0 - no testing required

1 - every batch at point of deposit

2 - one sample from every 10 batches, one sample per 20m^3 of concrete or one sample from each day's concrete, whichever involves the maximum number of samples.

3 - one sample from every 50 batches, one sample per 50m^3 of concrete or one sample from every three day's concrete, whichever involves the maximum number of samples.

5.20 Compliance with Specified Concrete Requirements

Of the three cylinders made from each sample of fresh concrete in accordance with the Specification, one will be crushed at 7 days and the other two at 28 days. The average of the

two 28 day strengths will be taken as the test result. Compliance with the specified strength requirements shall always be judged on the 28 days test results.

Concrete shall be considered to have failed to comply with the Specification:

a) if a test result is less than by 5% of working strength specified in Table 5-9 for that class of concrete, to which case the concrete which it represents shall be broken out and disposed of away from the Site by the CONTRACTOR unless at his sole discretion the ENGINEER approves otherwise;

b) if the average of four consecutive test results for that class of concrete shall have failed to exceed the working strength as specified in Table 5-9 in which case no further concrete of that class shall be placed in the Permanent Works until the CONTRACTOR shall have discovered the cause of such failure and rectified it to the satisfaction of the ENGINEER.

If a mix fails to achieve the requirements for fresh concrete the batch shall be rejected and no further concrete of that class shall be placed in the Permanent Works until the cause of failure has been rectified.

If test results for strength of concrete of any class are consistently and significantly in excess of the target mean strength the ENGINEER may on the application of the CONTRACTOR agree to a reduction in the cement content in the mix for that class, provided the cement content is not lowered below the minimum specified for that class, nor the maximum water/cement ratio exceeded.

5.20.1 Further Testing

When the ENGINEER agrees to or requires testing of the hardened concrete in a structure or precast element all such testing shall be carried out in accordance with the requirement of ASTM Designation C42, "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete".
In the event that the core-boring test indicates that the concrete placed does not conform to the Drawings and Specifications; the Engineer shall have the authority to prescribe corrective measures which may include removal and reconstruction of representative structure at Contractor’s risk and cost, the Contractor shall take such measures, to correct the deficiency.

5.21 Transporting, Placing and Compacting Concrete

The concrete shall be handled so that at the point of deposition it is of the specified quality and approved consistency, nothing having been added to it or lost from it since leaving the mixer. Any free water shall have been removed from the section to be concreted before concrete is deposited.

The CONTRACTOR shall obtain the approval of the ENGINEER to the arrangements he proposes to use for concreting before commencing concrete work.

The CONTRACTOR shall regard the compaction of the concrete as work of fundamental importance and shall produce a watertight concrete of maximum density compatible with the approved mix. Compaction shall be assisted by the use of mechanical vibrators of the immersion type, but shall not involve the vibration of reinforcement or shutters except that vibration of shutters may be allowed in precast concrete, with the approval of the ENGINEER. Vibrators shall be inserted at least to the full depth of the newly deposited concrete, kept in positron for about a quarter of a minute and then slowly withdrawn to prevent the formation of voids. The procedure shall be continuous with points of insertion 150 to 225 mm apart. The number and type of vibrators available for use during each period of concreting shall be to the approval of the ENGINEER, which will not be given if sufficient stand-by vibrators in good working order are not readily available. If concreting is in the dark, ample lighting shall be provided at the mixing stations and at every place where concrete is being deposited.

Concrete without a retarder which is not deposited in the Works within 30 minutes after the start of mixing shall not be used unless the ENGINEER approves otherwise.

Concrete may be pumped provided the mix design and the nature of pumping comply with the recommendations given in the `Guide to Concrete Pumping' as published by the Building Research Establishment (UK) and are not in conflict with any specified requirements.

The first batch of concrete to be made every time work is commenced shall contain 10% more cement than the normal amount.

Concrete shall be placed continuously up to positions of joints prepared prior to commencement of concreting. No concrete shall be dropped or chuted into the shuttering in such a manner as to cause segregation of the ingredients. In no case the concrete shall be allowed to fall freely from a height of 1.2 m or more. The deposited layers of concrete shall not exceed 600 mm in thickness. Shallow beams may be concreted to full height in one operation as directed by the ENGINEER. Care shall be taken to ensure that reinforcement projecting from concrete recently placed is not shaken or disturbed.

Where steps, splays and kickers occur these shall be cast in one with the slab and additional care shall be taken in the vibration and finishing techniques and procedures to ensure that thorough compaction is achieved and the unset concrete is not subjected to tension and no cracks are formed. The techniques and procedures to be adopted shall be discussed with the ENGINEER's Representative and his approval received before any such concreting is commenced.

5.22 Concreting in Unfavourable Conditions

The CONTRACTOR shall not place concrete in the Permanent Works:

(a) During heavy rains or dust storms.

(b) When the air temperature is more than 32°C.

(c) When the air temperature is less than 2°C.

(d) If the temperature of the concrete on discharge from the mixer is less than 4°C or more than 32°C.

(e) When the air temperature exceeds 25°C, without taking precautions and demonstrating to the approval of the ENGINEER that the maximum internal temperature of the concrete within 24 hours after casting in place is unlikely to be more than 30°C in excess of the ambient temperature or more than 60°C.

(f) If the temperature of the shutters or reinforcement exceeds 30°C.

To keep within these limits the CONTRACTOR may, among other means, spray aggregates with water, and use chilled mixing water, or add crushed ice direct to the mixer provided that no ice is present in the mix when discharged from the mixer.

When concreting in hot weather all material used shall be kept in the shade. Water tanks, mixers and chutes should be shaded, but where this is not possible they shall be painted white and kept white.

5.23 Concreting Records

A written record of the concrete works shall be made each day by the CONTRACTOR and kept available for inspection by the ENGINEER's Representative. The diary shall contain notes and records of:

(a) The names of the CONTRACTOR's engineers who are responsible for the different phases of the concrete work, and also the names of their assistants.

(b) The temperatures of air, water, cement, aggregates and concrete, together with the air humidity and type of weather.

(c) (Deliveries to the Site of concrete materials (quantity, brand of cement, etc).

(d) Inspections carried out, tests performed, etc, and their results.

(e) Times of commencement and completion of different parts of the concrete works, and times of erection and striking of forms.

(f) Quantity of cement, fine and coarse aggregate and admixture used for each section of work, and the number and kind of test samples taken on these ingredients and water.

5.24 Shuttering

The terms shuttering and formwork shall be interpreted as meaning one and the same thing, namely Temporary Works set up to obtain the required profiles and surface textures of the concrete. Shuttering shall be such that it remains rigid during the placing and setting of the concrete and prevents the loss of any concrete ingredients.

The shuttering shall be fixed in correct alignment and to the true shape and dimensions of the Permanent Works and shall be designed so that it can easily be removed for curing of concrete to commence as soon as practicable. Where necessary, shuttering should be so arranged that the soffit form, properly supported on props only, can be retained in position for such periods as may be required to allow the concrete to mature as specified in Clause 5.35. A method of support which would involve holes or tie wires extending the whole width from face to face of work to be concreted will not be permitted, unless authorised by the ENGINEER in writing. No plugs, bolts, wire ties, holdfasts or any other appliance whatsoever for the purpose of supporting the shuttering or reinforcement shall be fixed permanently into the structure so that they have less cover than that specified for the reinforcement or in any way impair the strength or appearance of the work, nor shall they be placed in such a manner that damage to the work would result in the removal of the same at the time of striking the shuttering.

Before the concrete is placed the retaining surfaces shall be cleaned of sawdust and shavings, dirt, other debris and standing water.

The inside of shuttering shall be coated with a release agent of non-staining mineral oil, mould cream emulsion or with other approved material. Adjacent concrete or reinforcement shall not be contaminated. The release agent must be compatible with any applied finish.

Temporary openings for cleaning and inspection before concreting shall be provided at the base of column and wall shuttering and where necessary. Shuttering for walls or other thin sections may have openings where approved by the ENGINEER for the placing and compacting of the concrete.

No concreting shall be started before the shuttering has been inspected by the ENGINEER's Representative. Unless otherwise approved, top shuttering shall be provided to concrete faces where the slope exceeds one vertical to three horizontal. Exposed arises shall be formed with a chamfer measuring 20 mm x 20 mm.

5.25 Surface Finishes

The faces of all concrete shall be left sound, solid, free from voids and to the class of finish specified.

No treatment to the finished concrete other than that specified in the class of finish shall be carried out unless approval to do so has been given by the ENGINEER.

Bolt bobbin holes shall be filled with cement and suitable fine aggregate mortar to match the colour of the concrete. The mortar shall be well worked in and thoroughly cured.

Classes for formed surfaces:

Class FI - This finish requires no special treatment and is for surfaces which will remain hidden in the permanent Works.

Class F2 - This finish is for all exposed surfaces unless otherwise shown on the Drawings. The formwork shall be faced with plywood or equivalent material in large sheets rigidly supported so as to prevent distortion under load. The sheets shall be arranged to coincide with architectural features, or changes in direction of the surface. All joints between panels shall be straight and either vertical or horizontal unless otherwise directed and the joints between panels to slab soffits shall be parallel to the supports. Suitable joints shall be provided between sheets to minimize joint marks and to maintain accurate alignment in the plane of the sheets. Facing sheets shall be free from blemishes which would affect the concrete surface.

Class F3 - This finish is identical to Class F2 finish except that the permitted deviations for irregularities are more stringent as given in Table 5-12.

Where a surface is partly below and partly above the final ground level the finish for exposed surfaces shall extend for 500 mm below the final ground level.

Classes for unformed surfaces:

Type UI - This finish is for surface, where a superior finish is not required. It is also the first stage for finishes U2 and U3. The finishing operations shall consist of grading, tamping and screeding the concrete to produce a uniform, plain or ridged surface.

Type U2 - This is a smooth matt finish such as may be achieved by a wood trowel, as required, inter alia, to receive mastic paving, or block or tile paving, bedded in mastic. Smoothing shall be done only after the concrete has hardened sufficiently, and may be by hand or machine. Care shall be taken that the concrete is worked no more than is necessary to produce a uniform surface free from marks.

Type U3 - This is a smooth steel-trowelled finish for surfaces of concrete paving,, tops of walls, copings and other members exposed to weathering or water, surfaces to receive thin flexible sheet, tile paving, bedded in adhesive, and seatings for bearing plates and the like where the metal is in direct contact with the concrete. Trowelling shall not commence until the moisture film has disappeared and the concrete hardened sufficiently to prevent excess laitance from being worked to the surface. The surfaces shall be trowelled by hand or machine under firm pressure and left free from trowel marks.

5.26 Permitted Deviations in Finished Work

The irregularities in formed and unformed surfaces for the various classes of finish shall be within the target limits shown in Table 5-12. If irregularities exceed the target the CONTRACTOR shall take the necessary steps to bring subsequent work within the target. If, however, the irregularities exceed the maximum allowable shown in the table it shall be sufficient cause for the structure, member or section of a member of the structure to be removed and properly reconstructed.

In Table 5-12, the type of irregularity is defined as follows:

(1) Departure from alignment, and grade and dimension shown on the Drawings.
(2) The cross-sectional dimensions of structural members less than 600mm, such as walls, columns, beams, etc., where, for structural reasons, it is desirable to keep the tolerances within closer limits than those for alignment and grade.

(3) Gradual irregularities measured from a 3 m long template placed against the concrete.
(4) Abrupt irregularities such as those resulting from defective or displaced facing or movement of supports.

Table 5-12: Permitted Deviations for Irregularities of Concrete Surfaces.

a) Formed finish

Type of Irregularity	Target			Maximum allowed		
	F1	F2	F3	F1	F2	F3
1	+ 20	± 5	+ 1	+ 40	+10	+ 2
2	+ 7	+ 5	+ 1	+ 15	+10	+ 2
3	7	5	+ 1	15	10	+ 2
4	7	3	+ 1	10	5	+ 2

b) Unformed finish

Type of Irregularity	Target			Maximum allowed		
	U1	U2	U3	U1	U2	U3
1	+ 20	+10	+ 3	+ 35	+ 20	+6
2	+ 7	+ 5	+ 3	+15	+10	+6
3	10	5	3	20	10	6

5.27 Fixing Reinforcement

Steel reinforcement shall be cut from straight bars free from kinks and bends or other damage, and cold bent by experienced competent workmen. Bars shall be bent in a bending machine approved by the ENGINEER. Cutting, bending and marking shall be to the tolerances and format given in BS 4466 unless otherwise specified or ordered by the ENGINEER.

The distance between any two parallel bars shall not be less than 5 mm more than the nominal maximum size of aggregate in the concrete, except at approved laps. The length of lap shall be as shown on the Drawings or ordered by the ENGINEER.

The CONTRACTOR shall place and fix steel reinforcement accurately in the positions shown on the Drawings and shall ensure that it remains rigidly in that position during the placing of concrete. Tack welding shall not normally be permitted, however, in particular cases it may be allowed with the prior approval of the ENGINEER. Supports, spacers, including PVC spacers, and ties shall be subject to the approval of the ENGINEER. Concrete spacers shall be made of the same quality concrete as that for the work in which they will be embedded with any tying wires galvanised and located to give a minimum cover specified for the reinforcement. Metallic spacers, fixing clips and tying wire shall be compatible with the material of the reinforcement, and the specified cover shall be maintained.
Spacers should be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete.

Reinforcement projecting from previously cast concrete shall not be bent so as to require re-bending without the prior approval of the ENGINEER.

The main wires of adjacent sheets of steel fabric reinforcement shall be lapped at least 300 mm and the transverse wires at least 150 mm.

The CONTRACTOR shall not place concrete around reinforcement until the reinforcement has been inspected by the ENGINEER's Representative.

5.28 Cover to Reinforcement

Except where otherwise shown on the Drawings the nominal concrete cover to the nearest reinforcement (exclusive of concrete blinding and rendering) shall be 40 mm. However, for internal faces in buildings the minimum cover shall be 20 mm exclusive of plaster or decorative finishes. This requirement does not apply to concrete faces in box-outs left for the installation of fixtures.

The actual concrete cover shall not differ from the nominal cover by more than ±5 mm for bars up to and including 12 mm size and ±10 mm for bars greater than 12 mm size.

5.29 Construction joints

Where not shown on the Drawings, the details and positions of construction joints shall be submitted to the ENGINEER for approval before any concreting takes place. They shall be located so that, when considered with the sequence of concreting, the effects of shrinkage and temperature are minimised.

Construction joints shall be watertight. They shall be formed in straight lines with rigid shuttering perpendicular to the principal line of stress and as far as practicable at points of least shear. They shall be the plain butt type unless otherwise specified or approved.

As soon as the exposed concrete has sufficiently hardened the surface of the joint shall be brushed with a stiff brush to expose the larger aggregate without it being disturbed. Roughening of the surface by chipping or hacking will not generally be approved. Before placing fresh concrete against a construction joint all loose material shall be removed and the surface sluiced with water until it is perfectly clean, thereafter all ponded water should be removed.

A period of at least 3 days and not more than 14 days, except under special circumstances and with the approval of the ENGINEER, shall elapse between the casting of successive lifts of concrete.

In the case of water retaining structures a maximum period of 7 days will be permitted to elapse between casting of the base or footing to a wall panel and the casting of the stem of the wall on such base or footing.

In case any joints have been shown on the Drawings, the CONTRACTOR will not be permitted to alter these joints or their positions or to increase or decrease their number.

5.30 Dowel Bar

Where dowel bars are to be provided through movement joints they shall be mild steel plain round bars with sawn cut ends and complying with ASTM A615/BS 4449.

In expansion joints the part of the bar to be free to move shall be coated with bond breaking compound as specified, encased in a rigid PVC or metal sleeve and fitted with a compressible cap of joint filler or other materials approved by the ENGINEER. The diameter of the sleeve should be the minimum necessary to allow free movement of the bar after concreting.

In full contraction joints the part of the bar to be free shall be coated with bond breaking compound as specified.

In joints between roofs and walls of reservoirs vertical dowel bars shall be provided with a rigid PVC or metal sleeve so packed with compressible material so as to allow a free movement of 5 mm in any direction in the horizontal plane.

5.31 Reinforcement at Partial Contraction Joints

Only 50% of the longitudinal reinforcement will be continuous at partial contraction joints in the walls of the conduit.

5.32 Pipes through Concrete Sections

All pipes passing through concrete to water retaining structures or where a thrust load has to be transmitted to the concrete shall be fixed in position before and rigidly held in position during concreting. Boxing out in either of the above circumstances will not be permitted, unless approved by the ENGINEER.

5.33 Protection and Curing of Concrete

The CONTRACTOR shall take measures to the approval of the ENGINEER for the protection of concrete from the harmful effects of wind, sun, high and low temperatures, rapid temperature changes, premature loading, deflection, impact and aggressive groundwater. Such measures shall continue from the time of the concrete is placed for a minimum of 7 days.

Concrete shall also be cured as follows. Unless otherwise approved by the ENGINEER, exposed concrete surfaces shall be kept continuously moist after casting for not less than 7 days after placing. Such surfaces, immediately upon exposure, shall be covered with thick hessian or sand or other material as may be approved by the ENGINEER, which shall be in continuous contact with the concrete and which shall be kept wet to the satisfaction of the ENGINEER.

For horizontal members such as slabs, exposed to wind and /or sun, special measures to prevent occurrence of shrinkage cracks shall be taken immediately after placing of concrete and until it is hard enough to commence curing as specified above. The measures shall include:

a) Erection of wind barriers and sun shades of suitable construction to provide adequate protection.
b) Application of water as a fog spray to keep the concrete surface moist without in any way damaging the fresh concrete or surface finish.

The ENGINEER may deny permission to place concrete unless necessary arrangements are available at the location of work to ensure compliance with above requirements.

5.34 Removal of Shuttering

Shuttering shall be removed in accordance with principles agreed by the ENGINEER and with the permission of the ENGINEER's Representative. Unless the soffit shuttering to beams and slabs has been designed so that it can be struck without disturbing the props, it shall be retained in position for the minimum period given in Table 5-13 for the retention of the props. Great care shall be exercised during the removal to avoid shocks to, or reversal of stress in, the concrete.

Earlier removal of formwork may be permitted by the ENGINEER by determination of the early strength of the concrete, in accordance with BS 8110 1985 CI 6.9.3.

Table 5-13: Minimum Period before Striking Formwork.

Type of formwork	Minimum period before Striking surface Temperature of concrete	
	16^{o} C	7^{o}C
i) Vertical formwork to columns, walls and large beams	18 hours	24 hours
ii) Soffit formwork to slabs	4 days	7 days
iii) Props to slabs	11 days	14 days
iv) Soffit formwork to beams	8 days	14 days
v) Props to beams	15 days	21 days

5.35 Cement Mortar

Unless otherwise specified the dry ingredients of cement mortar shall consist of one part of ordinary Portland cement to three parts of sand. The sand shall comply with BS 1200 with a grading complying with Table 1 thereof. The cement and sand shall be thoroughly mixed with

just sufficient water to make it workable. With the approval of the ENGINEER a non-shrink admixture may be used subject to the provision of Clause 5.4.

Cement mortar which has begun to set shall not be used or reworked for use in the Works.

5.36 Precast Concrete

Unless otherwise specified or described all precast concrete work shall be of Class “A” & “A(1)”.

Each mould for concrete work which is specified or approved by the ENGINEER to be precast shall have a different embossed or recessed identification mark in a position to the approval of the ENGINEER. Each precast unit shall be indelibly marked with the date of casting and after the mould is removed shall not be disturbed for 28 days. Each precast unit shall, where required, be provided with lifting eyes and holes located to avoid excess stress during handling to the approval of the ENGINEER.

Precast units must be of a sufficient age and handled with sufficient care to avoid permanent damage.

5.37 Building Ground Slabs

The position of all joints shall be indicated on the CONTRACTOR's Drawings. The joint types shall be indicated on the assumption that the slabs will be cast in chequer board fashion as defined in Cement and Concrete Association Publication 48.034 'Concrete Ground Floors.

Control joints may be substituted for transverse construction joints to permit the use of long strip casting in accordance with Cement and Concrete Association Publication 48.034 provided that:

a) The CONTRACTOR can demonstrate previous experience using this technique in ambient conditions similar to those prevailing on Site.
b) The joints layout is approved by the ENGINEER.
c) The joint is as detailed by the CONTRACTOR and approved by the ENGINEER and the crack inducer is in one piece between the side forms.
d) The groove is straight and sawn before random cracking occurs.

Fabric reinforcement may be located in the top face of a ground slab either by the use of chairs or, provided the concrete remains workable for an adequate period, by placing and compacting the concrete to the design level of the fabric, placing the fabric on the compacted concrete and placing and compacting the top layer of concrete to such a manner as to ensure the mixing of the layers.

The top layer of concrete not exceeding 50 mm deep shall be compacted using a double beam vibrating screed compactor.

Where the surface of a slab is to be sealed at a later date any curing membrane used shall be compatible with the use of the specified sealant.

5.38 Screeds

5.38.1 Concrete Mix

Screeds placed on concrete made with sulphate resisting cement shall themselves be made with sulphate resisting cement. The ENGINEER may at his discretion direct that the maximum aggregate size be reduced from 20 mm to 10 mm and that the maximum water cement ratio be reduced to not lower than 0.48 at no additional cost.

5.38.2 Mixing

Mixing shall be done in pan or paddle type mixers of a capacity matched to the rate of placing.

5.38.3 Surface Preparation

Where the screed concrete is placed more than 1 hour and less than 12 hours after the base concrete, the base concrete shall be brushed with brooms or wire brushes to remove laitance and expose clean aggregate.

Where the screed is placed more than 12 hours after the base concrete, the base concrete shall be well roughened to give a fresh face over the whole surface. Loose particles and dust shall be cleaned away and the surface then soaked with water. Immediately before placing the screed concrete the water shall be mopped from the surface and a stiff cement/water grout shall be brushed in.

Where the screed concrete is placed less than one hour after the base concrete and provided that no curing compound has been used the screed shall be placed directly on the concrete.

5.38.4 Screed Bay

Screed bays shall whenever possible be rectangular and shall not exceed 15 m^2, the length of a bay shall not exceed 1½ times its width. Screed bay shall not span joints in base concrete. Alternate bays shall be cast initially and no screed concrete shall be placed against other screed concrete placed less than 48 hours previously.

5.38.5 Screed Battens

Screed battens shall have a thickness the full depth of the adjoining screed and shall be fixed firmly to the base concrete so that they do not move under the action of the screening battens. Fixing shall be such that screening battens can be removed without disturbing the screed concrete. Battens shall not be removed until adjoining screed concrete has been placed for at least 12 hours.

5.38.6 Placing and Finishing

The screed concrete shall be placed as soon as possible after mixing. It shall be worked into place with a screening board with the screed alongside the battens trowelled into the corners. A preliminary pass with a vibrating screed board shall be made if conditions permit. The surface shall be worked with a power float if conditions permit. Unless otherwise shown the finish of screeds shall be Type U3.

5.39 Protective Coatings to Concrete

Where ordered by the ENGINEER or shown on the Drawings, waterproof coatings shall be applied to concrete structures in order to protect the concrete against the aggressive effects of saline groundwater. Generally, protective coatings will be applied to surfaces of structures which are close to or in contact with groundwater.

Before applying any coating the surface of the concrete shall be cleaned of all dirt, dust and loose material and where necessary any surface shall be made good so that the surface is smooth and free from air or water holes. No coating shall be applied until the ENGINEER has approved the preparatory work.

The coating shall be applied using Bituproof bituminous coatings as manufactured by Colas Products Limited, Riverside, saltney, Chester, UK, or similar approved coatings. The grades of coating and the method of application shall be as follows:

5.39.1 Priming Coat

An application of Bituproof Type 3 diluted with an equal volume of water, shall be well scrubbed into the concrete and allowed to dry.

5.39.2 First Coat

A heavy brush coat of Bituproof Type 5 containing a cement slurry, consisting of 1 volume of sulphate resisting cement, 1 volume of water and 10 volumes of Type 5, shall be laid on in

one direction and allowed to dry. To introduce the cement slurry to the Bituproof, the cement shall be mixed thoroughly with the water, the whole being added to the Bituproof, stirring thoroughly to ensure uniform dispersion. The Bituproof/cement slurry mix shall be used within one hour of preparation.

5.39.3 Second and Subsequent Coats

A heavy brush coat of Bituproof Type 5/cement slurry mix prepared as for the previous coat shall be laid on at right angles to the previous coat and allowed to dry.

The application rate for the above primer and subsequent coats shall provide not less than 0.75 kg of Bituproof per m^2.

Each coat shall be thoroughly dry before applying a subsequent coat and shall be considered as dry when no staining occurs on a wet finger which is rubbed vigorously over the coating. No coat shall be immersed in water for at least ten days after it is dry.

The coating shall only be applied to the surfaces when shaded from direct sunlight and the coated surfaces shall continue to be shielded until the final coat is dry.

In order to provide protection to the underside of structures, the bituminous coatings shall be applied to the blinding layer before the placing of the structural concrete. The blinding layer shall be given a Type U2 finish.

The blinding and protection shall extend beyond the outer edge of the structural concrete at least 0.1 m so that subsequent coatings applied to the structural concrete can overlap the blinding layer and provide unbroken protection. The structural concrete shall not be placed on the blinding layer until the protection is thoroughly dry nor in any case until 60 hours have elapsed following the completion of the protection.

5.40 Provision of Hydrophillic Waterstop in Joints between exisitng & New Construction

The joint between existing and new concrete shall be provided with hydrophilic water proofing compound strip of size 25mm x 20 mm at the locations shown in drawings. These stripes comprise of rubber based bentonite compounds and are marked in Pakistan under trade names of supercast SW or expandastop. However, other equivalent Hydrophilic Water proofing compound strips which are old tested products and (are with similar properties & functions) will also be acceptable.

The hydrophilic waterstop strip shall be fixed by experienced personel as per manufacturers recommendations using recommended adhesives to provide excellent adhesion to the concrete. No nails or steel fixtures are to be used and these should be minimum cover of 100 mm concrete over the hydrophilic waterstop.

The CONTRACTOR is required to submit for approval necessary test report about the suitability and compatibility of the material for use in the project under Karachi climatic conditions. The CONTRACTOR shall also provide manufacture's guarantee for performance and durability of the product for atleast 20 years.

5.41 Water Tightness of the Chambers / Structures

The CONTRACTOR is responsible to construct the structures water tight and take necessary precautions at every stage of construction so as to ensure that no leakage or seepage occurs when filled with running water. The CONTRACTOR may also engage a specialist firm to advise him on how to ensure water tight construction and, if required and approved by ENGINEER, supplement water proofing arrangement of the joints provided in the drawings. Costs of all such measures are deemed to be included in the quoted rates / overheads of the CONTRACTOR.

6.0 PLASTER AND POINTING GENERAL

6.1 Scope

The section outlines the general requirements and procedures for all types of plaster and pointing works.

6.2 Materials Requirement

a. Portland Cement and Water: Portland cement and water shall conform to the requirements, laid down in Section 5.1.
b. Sand for Mortars: Sand, for mortars, shall be shall be clean and free from organic matters, silt, clay and other deleterious substances.

6.3 Samples

a. The samples of all the materials, to be used for plaster and pointing work, shall be approved by the Engineer and same type of material shall be used during the work.
b. If the Engineer desires to get the material tested, this will be got done by the Contractor, at his own expense from a laboratory, approved by Engineer.

6.4 Mortars for Plaster and Pointing Works

6.4.1 Mix Proportions

The materials and their mix proportions, by volume, for mortars, for plaster and pointing work, shall be as shown in the Drawings and/or specified in the Bill of Quantities.

6.4.2 Preparation of Mortar

a. Component materials, excluding water, shall, first, be thoroughly mixed in dry state, on a paved platform or on metallic sheets.
b. Water shall be added, in sufficient quantity, to make the mortar workable. Water shall be added, in a manner, so that segregation of cement does not take place.
c. Through mixing of the mortar shall be carried out to produce a homogenous workable mass.
d. Mixing shall be done mechanically, unless otherwise specifically permitted by the Engineer.
e. Specified proportions of the mixing materials shall be accurately controlled and maintained.

6.4.3 Use of Mortar

a. Only such quantity of mortar shall be prepared, as can be used before the initial setting time of cement.
b. Any mortar, which has initially set, shall not be used.
c. At the close of day's work, the mixing troughs, pans or platforms shall be thoroughly washed and cleaned.

6.5 Construction Requirements

6.5.1 Applicable to Plastering and Pointing

a. Instrument Cleaning: All tools and instruments, used for mixing, transporting and applying mortars, shall be clean and free from set mortar, dirt, or other injurious foreign substances. It shall be thoroughly cleaned, at the end of each day's work.

b Scaffolding

i. Necessary and suitable scaffolding shall be provided to facilitate plaster and pointing work, in superstructures.
ii. Scaffolding shall be sound and strong enough to withstand all loads likely to come upon them.
iii. All put-log holes shall be filled up, as the scaffolding is being taken down.

c. Preparation of Masonry Surfaces: Prior to plastering and pointing works, the joints of all masonry shall be raked out with a hook to a depth of 1/2" (13 mm). The mortar

dust coming out of these joints as a result of raking shall be cleaned with a stiff wire brush.

d. Precautions and Protection: All plaster and pointing work shall be protected, during construction, from the effect of rain and frost.

e. Defective Work: Defective and damaged work, due to any reason, shall be made good, by the Contractor, at his own cost, without any extra claim.

6.5.2 Applicable to Plastering

a. Curing: The plaster works, laid in cement mortars, shall be properly water cured, by keeping them wet, for at least 7 days, in a manner approved by the Engineer. The brick masonry surfaces shall be watered for 24 hours, before plastering.

b. Preparation of Concrete Surfaces: In case of cement concrete to receive plaster, all surfaces shall be roughened at the Contractor's cost by dragging wire brushes when the concrete surface is yet raw or by chiseling if the surface has been hardened.

c. Extent: Plaster shall be carried out to the full length of the wall or to the natural points.

7.0 PLAIN PLASTER WORK

7.1 Description

a. This work shall consist of furnishing and laying all type of plain plaster work, of specified thickness, in specified mortar, in any position, irrespective of the location, depth, height and shape, in accordance with these specifications and to the lines, grades and thickness, as shown on the Drawings and/or as directed by the Engineer.

b. All the provisions of Section 11.1.1 shall apply to this section of specifications.

7.2 Material Requirement

a. Common materials, used in the plain plaster work, shall conform to the requirements, laid down or referred in Section 5.1.

b. Plaster stops, corner guards and beads shall be of galvanized metal.

7.3 Construction Requirements

7.3.1 Mortar

a. The materials and their mix proportions, by volume, for mortars, for the plain plaster work, shall be as shown in the Drawings and/or specified in the Bill of Quantities.

b. Preparation and use of mortars, for the plain plaster works, shall be in accordance with the requirements, laid down in Section 7.4.

7.3.2 Plastering

a. The plain plaster shall be laid and finished, to a smooth, uniform, leveled and plumbed surface, free from patches, undulations, cracks, blisters, blow holes, trowel marks and other defects.

b. The plastered surface shall be tested, frequently, for undulations, with a straight edge not less than 10 feet in length. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb-bob, as the work proceeds.

c. Finishing of the surface shall be done with steel or wooden floats, as directed by the Engineer.

d. Where shown in the Drawings or directed by the Engineer, grooves, of specified size and patterns, shall be made, in the plaster.

e. Not more than 1/2" (13 mm) thick plaster shall be done in one layer.

f. If the specified plaster thickness is more than 13 mm (1/2") then the Engineer may direct plaster to be applied in two coats comprising rendering coat and the final coat. Rendering coat shall be roughened with waving lines drawn by wire brushes to provide bond for the final coat and it shall be properly moistened before application of subsequent coat. The final coat shall be finished with floats to present smooth and uniform surface.

g. Where shown or directed, plaster stops and beads shall be used.

7.4 Measurement

a. Measurement, for plain plaster work, will be made in the specified units of surface area, of plaster, of specified thickness, laid in specified mortar, acceptably placed, on the basis of the dimensions, for the neat finish lines, in accordance with the Drawings or directions of the Engineer.

b. Deductions will be made, for all the openings.

7.5 Rate and Payment

a. Payment, for plain plaster work, of specified thickness, laid in specified mortar, will be made for the quantity of plastering, measured in accordance with Section 8.4, at the unit rates, tendered in the priced Bill of Quantities.

b.

c. The unit rates tendered, for all items of plain plaster work, shall be deemed to be inclusive of, but not limited to the following:

   i. Providing all materials including mortar additives
   ii. All operations related with transportation, involved in the process
   iii. All operations related with storage of materials
   iv. All sorts of wastages

v. All operations including mortar preparation; laying and finishing of plaster; construction of drip courses; fabrication and erection of scaffolding; and curing, protection, maintenance and repairs, of plaster work
vi. Carrying out all sampling and testing
vii. All other operations, procedures and requirements necessary to complete the work in accordance with these specifications.

d. Where specified in the Bill of Quantities, the unit rates tendered, for all items of plain plaster works, shall be deemed to be inclusive of the all materials and operations related to the following:

i. Installation of plaster beads, corner guards and stops
ii. Construction of grooves in plaster

8.0 PIPING WORKS – GENERAL

8.1 Scope

The section outlines the general requirements and procedures for all types of piping works including pipe appurtenances. All the relevant provisions of this section shall apply to the Chapters 10.0, 11.0 and 12.0.

8.2 Samples and Tests

The samples of all the pipes, fittings, specials and accessories, to be provided for the piping works, shall be approved by the Engineer and same type of material shall be used during the work. If the Engineer desires to get the material tested, this will be got done by the Contractor, at his own expense, at the site or from a laboratory, approved by Engineer, as the case may be.

8.3 General Requirement

a. All the specified materials, piping, fittings, specials, and accessories shall be of the high quality, free from defects, such as breaks, flaws, or other imperfections.
b. Where required, the joists, beams, slabs and walls, through which the pipe must pass, shall be drilled in such a way that the building will not be structurally weakened.
c. Various materials and works, covered elsewhere in these Specifications, where used for the execution of the piping works, shall comply with the requirements of the relevant Sections.

8.4 Protection

The Contractor shall take care to protect the work from any damage, of whatsoever nature, during the construction period. In case of any damage done, to the work, the Contractor shall remove, replace, or rectify such work at his own cost, without any additional compensation.

8.5 Painting

Except where otherwise specified, all ferrous metal surfaces except working parts, machinery, galvanized surfaces and other surfaces not normally painted, shall receive one coat of rust inhibitive metal primer or red lead paint and two coats of finish painting, with enamel paint, of approved color.

8.6 Shop Drawings

a. Where called for in the drawings or directed by the Engineer, the Contractor shall prepare and submit, for the approval of the Engineer, shop drawings, for the piping works, showing all details, in accordance with the instructions of the Engineer.
b. Shop drawings shall show, in detail, the materials, method of construction and erection data.
c. The shop drawings, where required to be modified or revised, by the Engineer, shall be re-submitted, until approved.

8.7 Installation of Piping Works

8.7.1 General

a. Pipe and accessories shall be handled in such a manner as to ensure their delivery to the desired location in sound, undamaged condition. Pipe shall be carried into position and not dragged.
b. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before installation and shall be kept clean during laying operations by plugging or other approved method.
c. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material.
d. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place and protected against the direct rays of the sun.
e. Pipe cutting shall be done in a neat and workman like manner without damage to the pipe. Unless otherwise authorized by the Engineer or recommended by the manufacturer, cutting shall be done with a mechanical cutter of approved type.

f. Pipe ends left for future connections shall be valved, plugged or capped, and anchored, as shown or as directed.

8.7.2 Pipe Placing and Laying in Trenches

a. Pipe and accessories shall be carefully lowered into the trench by means of derrick ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the piping materials be dropped or dumped into the trench.
b. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bell, coupling and joints.
c. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until the materials in the joints have hardened.
d. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substances will enter the pipes or fittings.

8.7.3 Pipe Installation on Supports

a. Every horizontal pipe line attached to walls, beams, ceilings or other structures, shall be supported by galvanized holder bats placed, securely, into the structure, at intervals not exceeding 1.8 m (6'), throughout, its length and at all changes, in direction, to ensure that the deflection does not exceed 3mm (1/8").
b. Vertical pipes shall be provided with heavy iron clamps, at intervals not exceeding 2.4 m (8').
c. Hangers, supports and clamps shall be secured, to the structure, by providing inserts in the concrete, or by means of fishplates, in cases of heavy loads.
d. Piping, attached with the structure shall not touch it and a minimum clear gap of 50mm (2") shall be maintained everywhere.
e. Where provided for, the pipe lines, crossing any walls, slab, beam or any other structure, shall be arranged to pass through sleeve pipes, as shown in the Drawings or specified in the Bill of Quantities.

8.8 Inspection and Testing of Piping Works

a. When a length of pipe has been laid and jointed the Engineer shall be informed so as to enable him to make an inspection of the length, and no such length shall be covered up until the Engineer has given his approval in writing.
b. All pipes shall be tested in the presence of the Engineer after the pipes have been laid and jointed and before any filling or concrete protection is placed.
c. Any defective work, revealed by the tests, shall be made good to the satisfaction of the Engineer, at the Contractor's expense and the tests repeated until satisfactory result is obtained.

8.9 Pavement Restoration

The contractor shall temporarily restore paved surfaces, which have been cut under this contract, as part of the work under the excavation items and at no extra cost to the Owner. The permanent pavement restoration work will not form part of the work under this contract.

9.0 PRESSURE PIPELINES AND APPURTENANCES

9.1 Description

a. This work shall consist of furnishing and installing all types of pressure pipelines and appurtenances for carrying water, wastewater and rainwater, in accordance with these specifications and to the lines, grades and cross-sections shown on the Drawings and/or as directed by the Engineer.

b. All the relevant provisions of Chapter 9.0 shall apply to this section.

c. Fittings, in this section, in general, shall mean to include bends, tees, wyes, crosses, reducers/tapers and plugs/blanks.

d. Specials, in this section, in general, shall mean to include sluice or gate valve, check valve, air relief valve and fire hydrants.

9.2 Materials Specification

The materials, covered therein, shall conform to the provisions, referred in Chapter 9.0 and the following requirements.

9.2.1 Asbestos Cement (AC) Pressure Pipes and Couplings

AC pipes and couplings shall conform to requirements of International Organization for Standardization Recommendation R160 "Asbestos Cement Pressure Pipe" or BS 486:1973 "Asbestos Cement Pressure Pipes", for the specified class. The test and working pressures for various classes of pipes should be as under:

Table 10-1: Test and Working Pressures for classes of AC pipes.

Class	Test Pressure meter (feet)	Working Pressure meter (feet)
12	120 (400)	60 (200)
18	180 (600)	90 (300)
24	240 (800)	120 (400)

9.2.2 Galvanized Iron (GI) Pipes and Fittings

a. General: Galvanization shall conform to the requirements of BS 729. All threaded pipes and fittings shall have threads, in accordance with BS 21.

b. Pipes: The GI pipe shall conform to the requirements of BS 1387:1967. The test pressure for all classes (L, M and H) of GI pipe shall be 700 psi.

c. Fittings: The material, wall thickness and galvanization quality, for the GI fittings, shall be same as that for the specified GI pipe.

9.2.3 Polyvinyl Chloride (PVC) Pressure Pipes and Fittings

Polyvinyl Chloride (PVC) pipes shall conform to the requirements of BS 3505:1968, for the specified class. The test and working pressures for various classes of pipes should be as under:

Table 10-2: Test and Working Pressures for classes of PVC pipes.

Class	Test Pressure meter (feet)	Working Pressure meter (feet)
B	90 (300)	60 (200)
C	135 (450)	90 (300)
D	180 (600)	120 (400)
E	225 (750)	150 (500)

9.2.4 Cast Iron Pressure Pipes and Fittings

Cast iron pressure pipes and fittings, socket/spigot and flanged type, shall conform to the requirements of BS 4622:1970. Cast iron threaded companion flanges, shall conform to the requirements of BS 10:1962 (Table D). The working pressures for various classes of pipes and fittings should be as under:

Table 10-3: Test and Working Pressures for classes of CI pipes.

Class	Working Pressure meter (feet)
1	100 (325)
2	125 (400)
3	160 (520)

9.2.5 Ductile Iron Pressure Pipes and Fittings

Ductile iron pressure pipes and fittings, socket and spigot type and flanged type, shall conform to the requirements of BS 4772:1971 and ISO 2531.

9.2.6 Flow Control Valves

Cast iron sluice/gate valves shall be of metal seated wedge type, conforming to BS 5163. Ends of valves shall be suitable for the type of pipe to which the valves will be connected. The sealing ring and spindle should be made of gunmetal.

9.2.7 Check Valve

The cast iron check valves shall be of cast iron body, with swing type gunmetal door, conforming to the requirements of BS 5153. Ends of valves shall be suitable for the type of pipe to which the valves will be connected.

9.2.8 Air Relief Valve

The cast iron relief air valve, of specified inlet size, shall be of small orifice, large orifice or double orifice type, as specified. Inlet of valve shall be flanged or threaded, to suit the type of pipe, on which it is to be installed.

9.2.9 Fire Hydrant

The fire hydrant, streamline screw down type for external application, shall conform to BS 750. The direction of closing shall be by clockwise rotation. Flanged inlet of the fire hydrant shall be of size 80 mm (3") and outlet, of internal dia 54 mm ($2^{1}/_{8}$"), shall be externally threaded, to receive hose connection.

9.2.10 Fiber glass Reinforced Plastic (FRP) Pressure Pipes and Fittings

a. All FRP pressure pipes and fittings shall be manufactured from thermosetting resins with glass fiber reinforcement.

b. All FRP pipes shall be manufactured by either a centrifugal casting or by a filament winding process and each glass fiber used shall be continuous filament, thoroughly impregnated with resin.

c. Fiber glass reinforced plastic (FRP) pressure pipes shall conform to the requirements of the following applicable standards of ASTM:

Table 10-4: ASTM standards for FRP pressure pipes.

Pipe Size	Standard
< 150 mm	ASTM D2996 “Standard Specifications for Filament Wound Reinforced Thermosetting Resin Pipe”
< 150 mm	ASTM D2997 “Standard Specifications for Centrifugally Cast Reinforced Thermosetting Resin Pipe”
> 200 mm	ASTM D3517 “Standard Specifications for Fiberglass (Glass-Fiber Reinforced Thermosetting Resin) Pressure Pipe”

d. The test and working pressures for various classes of pipes and fittings shall be as under:

Table 10-5: Test and Working Pressures for various classes of pipes and fittings.

Class	Test Pressure Head meter (feet)	Working Pressure Head meter (feet)
B	90 (300)	60 (200)
C	135 (450)	90 (300)
D	180 (600)	120 (400)
E	225 (750)	150 (500)

e. Except where otherwise specified, the glass-fibers shall be of E type glass, with low alkali contents and following characteristics:

Minimum Tensile Strength	3500 MN/m_2
Modulus of Elasticity in Tension	73 GN/m_2

f. Except where otherwise specified, the thermosetting resin shall be Vinylester resin, with suitable curing agents, in accordance with the manufacturer's recommendations.

g. Where called for in the drawings or directed by the Engineer, the Contractor shall prepare and submit, for the approval of the Engineer, shop drawings, for the FRP pipes and fittings, showing the fabrication details, in accordance with the instructions of the Engineer. Shop drawings shall show, in detail, the materials, design data, fabrication data and method of fabrication. The shop drawings, where required to be modified or revised, by the Engineer, shall be resubmitted, until approved.

9.3 Pipeline installation

9.3.1 General Requirements

Connections between different types of pipes and accessories shall be made with transition fittings, in accordance with the manufacturer's recommendations.

9.3.2 Asbestos Cement (AC) Pipelines

a. Except where otherwise specified, Class 12 pipe shall be used for AC pressure pipelines.
b. AC pipes shall be jointed, by means of AC coupling, in accordance with recommendations of the pipe manufacturer.
c. Except where otherwise specified, cast iron fittings (socket and spigot type) shall be used, on AC pipeline works.

9.3.3 Galvanized Iron (GI) Pipelines

a. General
   i. Except where otherwise specified, Class M pipes shall be used for GI pressure pipelines.
   ii. Except where otherwise specified, GI pipes shall be joined by means threaded sockets and unions and GI threaded fittings shall be used on GI pipeline works.
   iii. Where specified, GI pipes shall be joined by means of threaded malleable iron companion flanges.
   iv. Where specified, cast iron flanged fittings shall be used on GI pipeline works.
   v. All underground GI pipes and fittings shall be externally treated with one coat of hot applied bitumen (Special Industrial Bitumen: 10/20) and one layer of polythene sheet (300 gms), duly wrapped around.

b. Laying with Threaded Joints
   i. In order to prevent damage, to the leading thread, the ends of sockets shall be chamfered internally.
   ii. All threaded joints, both internal and external shall be examined before jointing to ensure that the threads are perfect for the full depths of the joints.
   iii. The jointing work shall be so arranged, that the ends of pipes, jointed thereby, shall be equi-distant, from the middle of the socket and shall have a space of not more than about 13 mm ($^1/_2$"), between them, in the center of the socket.
   iv. Prior to screwing, few very thin strands of best quality local cotton yarn, smeared over with paste of red and white lead, shall be carefully wound, in the grooves of the threads, from end to end of the joint.
   v. Red and white lead paste shall be made by mixing, together, dry red lead and moist white lead and then thinning out, into a paste, with boiled linseed oil.
   vi. The pipes shall be screwed up tightly with pipe fitter's tongs or pipe wrenches to ensure that each and every joint is perfectly water tight, against the test head of

water.

vii. No red and white lead paste or cotton yarn shall project outside the ends of the joints.

9.3.4 Polyvinyl Chloride (PVC) Pressure Pipelines

a. Except where otherwise specified, Class B pipes shall be used for PVC pressure pipelines.
b. Except where otherwise specified, PVC fittings (socket and spigot type) shall be used, on PVC pipeline works.
c. Except where otherwise specified, PVC pipes shall be of socket and spigot type, to furnish push-on type joints, with rubber ring for sealing, in accordance with recommendations of the pipe manufacturer.

9.3.5 Cast Iron (CI) Pressure Pipelines

a. CI pressure pipes and fittings shall be flanged or socket and spigot type, as specified, and shall be joined in accordance with recommendations of the pipe manufacturer.
b. Except where otherwise specified, Class 1 cast iron pipes and fittings shall be used for pressure pipelines.

9.3.6 Ductile Iron (CI) Pressure Pipelines

DI pressure pipes and fittings shall be flanged or socket and spigot type, as specified, and shall be joined in accordance with recommendations of the pipe manufacturer.

9.3.7 Fire Hydrants and Valves

Valves shall be set plumb and in accordance with the manufacturer's instructions. Valves shall have the interiors cleaned of all foreign matter before installation and they shall be inspected in open and closed positions to ensure that all parts are in working condition.

9.3.8 Valve Chambers

In all underground installations, valves shall be housed in valve chambers. Earth fill shall be carefully tamped around each valve chamber, to the satisfaction of Engineer.

9.3.9 Reaction Backing

a. Where specified, plugs, dead ends, tees and bends, on pipelines, shall be provided with concrete reaction backing blocks.
b. Backing blocks shall be placed between solid ground and the fitting to be anchored.
c. Except where otherwise specified the concrete, for reaction backing blocks, shall be of cast-in-situ Portland cement concrete, Class D.
d. Where no reaction backing blocks are provided at fittings, like plugs, dead ends, tees, wyes and bends, of the pressure pipelines; all the joints, within at least a distance of 33’ (10 m) from the fittings (excluding the pipelines along main legs of the tees or wyes), shall be able to safely withstand the maximum estimated tension.

9.3.10 Fibre glass Reinforced Plastic (FRP) Pressure Pipes and Fittings

a. Except where otherwise specified, Class B pipes and fittings shall be used for FRP pressure pipelines.
b. FRP pipes and fittings shall be flanged type or socket & spigot type, as shown in the Drawings, or directed by the Engineer.
c. Except where otherwise specified, flanged joint for FRP pipes shall be provided with rubber gasket and stainless steel bolts & nuts.
d. Except where otherwise specified, socket and spigot joint for FRP pipes shall be push-on type, with rubber O-ring for sealing, in accordance with recommendations of the pipe manufacturer.

10.4 Flushing of Pipelines

(DELETED)

10.5 Leakage Test

a. Leakage test shall be required to be carried out in all types of pressure pipelines, meant for carrying potable water, wastewater and rainwater.

b. Flushing of the pipe line shall be followed by a leakage test, with all joints left exposed. Leakage test shall be performed by keeping the end of the pipe line closed by proper plugs, blocked to resist 150 percent of the test pressure..
c. Before the testing of pipeline, the Contractor shall ensure that concrete backing blocks have been provided, where necessary. The test shall be performed only, after all concrete work in contact with pipe to be tested has set for a minimum of 24 hours.
d. The pipeline shall be filled with water. While filling the pipeline, all valves and openings shall be kept open and water shall be filled in slowly. When the pipe line is completely filled with water and all air expelled, water shall be pumped into the pipe line to the specified test pressure, which shall be maintained for at least 2 hours.
e. Each and every joint shall be inspected for leaks.
f. If visible leakage takes place in any joint than a displacement leakage test shall be performed. A measured quantity of water shall be pumped into the pipe line and the test pressure be maintained for two hours.

g. No piping installation will be accepted until the leakage is equal or less than the number of imperial gallons per hour as determined by the following formula:

$$L = 0.00045\ ND\ (P)^{0.5}$$

L = Leakage, in imperial gallons per hour
N = Number of joints
D = Nominal diameter of pipe, in inches
P = Average test pressure during test, in psi

h. In the event of the pipe line failing the leakage test, the Contractor shall locate and repair the defective pipe, fitting or joint at his expenses.
i. After repairs of the line, the Contractor shall retest the line. The line will not be accepted until it passes the leakage test.
j. Except where otherwise specified or directed by the Engineer, the test pressure, for water pipelines, shall be 45 meters (150 feet).

9.6 Retesting For Pipeline in Trenches

a. Retesting for leakage shall be required to be carried out in those potable water, wastewater and rainwater carrying pressure pipelines that are laid in trenches.
b. After the pipe trench has been backfilled, the entire line shall be subjected to a leakage test as a whole unit.
c. The Contractor shall repair the line if it fails to pass the leakage test requirements specified herein before. The test shall be repeated and repairs affected until the pipe line passes the leakage test.

9.7 Pipeline Disinfect Ion

(DELETED)

9.8 Measurement

Except where otherwise specified in the Bill of Quantities, measurement, for various water, wastewater and rainwater carrying pressure pipeline works items, of specified materials, quality and sizes, will be made in the following units, of these items, acceptably placed, in accordance with the approved Drawings or directions of the Engineer:

a. Pipes, with fittings of same material as that of pipe, shall be inclusive of the fittings and shall be measured, in specified units, of the center-line length, of the pipeline. No deduction will be made for the laying lengths of fittings and specials, installed on the pipelines.
b. Pipes, with fittings of different material than pipe, shall be measured, in specified units, of the center-line length, of the pipeline. No deduction will be made for the laying lengths of fittings and specials, installed on the pipelines.
c. Cast iron fittings, bell and spigot type or flanged type, where installed on pipes of different material, shall be measured, in specified units, of weight.
d. Specials, with or without valve chambers, as the case may be, shall be measured, in numbers, of these items.

e. Reaction backing blocks, for fittings, including backing, tension and compression blocks shall be measured in shall be measured, in specified units, of volume of concrete, installed.
f. Water supply service connection shall be measured, in numbers, of these items.

9.9 Rate and Payment

9.9.1 Payment

Payment for various water, wastewater and rainwater carrying pressure pipeline works items, of specified materials, quality and sizes, will be made for their respective quantities, measured in accordance with Section 10.9, at the unit rates, tendered in the priced Bill of Quantities.

9.9.2 Rate

The unit rates tendered, for various items of water, wastewater and rainwater carrying pressure pipeline works, shall be deemed to be inclusive of, but not limited to the following:

a. Common Applicable to All Items
   i. Providing all materials, including clamps, supports, hangers, puddle plates and materials for painting/coating, protective treatment, welding, fastening, anchoring and sealing
   ii. All sorts of transportation involved in the process
   iii. All sorts of wastages
   iv. Operations including application of protective treatments, on pipes and fittings; fabrication, assembling, installation and painting of clamps, supports and hangers; and maintenance, protection and repairs, of the work
   v. Preparing shop drawings
   vi. Carrying out all sampling and testing
   vii. All other operations, procedures and requirements necessary to complete the work in accordance with these specifications.

b. Pipes, with Fittings of Same Material as that of Pipe
   i. Providing all materials, including pipe and fittings
   ii. Operations including cleaning, cutting, jointing and installation of pipes and fittings; flushing and testing of pipeline; and disinfecting the pipeline (in case of water supply lines only)

c. Pipes, with Fittings of Different Material than Pipe
   i. Providing all materials, including pipe (Fittings to be paid separately)
   ii. Operations including cleaning, cutting, jointing and installation of pipes; flushing and testing of pipeline; and disinfecting the pipeline (in case of water supply lines only)

d. Cast Iron Fittings: to be paid separately, only, where installed on pipeline of different material.
   i. Providing all materials, including fittings
   ii. Operations including cleaning, jointing and installation of fittings; flushing and testing; and disinfecting (in case of water supply lines only)

e. Specials, with or without valve chambers, as the case may be:
   i. Providing all materials, including specials and materials for construction of valve chambers (in case valve chamber is included).
   ii. Operations including cleaning, jointing and installation of specials; flushing and testing; disinfecting (in case of water supply lines only); and all operations involved in the construction of valve chamber (in case valve chamber is included).

f. Reaction Backing Blocks
   i. Providing all materials, including metal straps
   ii. All operations including excavation, installation of straps and all operations required for laying of concrete.

g. Water Supply Service Connection
   i. Providing all materials including saddle assembly, copper ferrule, flexible copper tube and tube to GI pipe adopter.
   ii. All operations including excavation, drilling in the pipe main and installation of service connection.

10.0 VALVES

10.1 Description

a. This work shall consist of providing, installing, testing, commissioning furnish all labor, equipment, materials, tools, supplies, fittings, including gasket, steel nuts, bolts & washer and appurtenances required for the support, installation, protective coating, and testing of valve in the locations shown, and all appurtenant work, for a complete and workable installation as specified herein, in accordance with the requirements of the Contract Documents (where included in the BOQ), in accordance with these specifications and to the layouts and details, shown on the Drawings and/or as directed by the Engineer.

b. The items specified under this Section shall be furnished by manufacturers having experience in the manufacture of similar products for a period of at least 5 years.

c. All valve items shall be manufactured of material suitable for the water, wastewater, sludge and air they serve, and shall be certified for such use on the shop drawings.

d. All the relevant provisions of Section 20.16 shall apply to this section.

e. Characteristics of the valve, included in this Contract, are given in Sub-section 20A16 of Section 20A “Schedule of Equipment”, which is annexure to the Sections of Specifications, of reference number starting with 20.

10.2 General Requirements

10.2.1 Shop Drawings

The CONTRACTOR shall furnish shop drawings of all items and accessories in accordance with the General Requirements. Shop drawings shall include detailed design calculations stamped by a registered engineer, bill of materials listing all valve components, materials, tools, supplies, fittings, and appurtenances, etc., with manufacturer's name, trade and identification marks.

All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products; such manufacturers shall have had previous experience in such manufacture and shall, upon request of the ENGINEER, furnish the names of not less than 5 successful installations of its equipment of comparable nature to that offered under this contract.

All combinations of manufactured equipment which are provided under these Specifications shall be entirely compatible, and the CONTRACTOR and the listed manufacturer shall be responsible for the compatible and successful operation of the various components of the units con- forming to specified requirements. All necessary mountings and appurtenances shall be included.

All materials employed in the manufacture and installation of the valves shall be suitable for the intended application; material shall be high-grade, standard commercial quality, free from all defects and avoid imperfection that might affect the serviceability of the product.

Wetted parts of all valves shall be selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free operation for the fluid involved.

10.2.2 Data Requirements:

The drawings and data submitted shall include the following:

a. Name of manufacturer.
b. Dimensions of Valve.
c. Data sheet for pressure test.
d. Equipment weights.
e. All materials of construction listed and applied coating.

10.3 Manufacturer or equal

a. Val Matic
b. SISTAG
c. KITZ
d. COSMOS Engineering Co.
e. KSB
f. SCON

10.4 General Installation Requirements

10.4.1 General

Valves shall be installed in accordance with procedures submitted with the CONTRACTOR approved shop drawings and as shown, unless otherwise acceptable to the ENGINEER.

10.4.2 Alignment

Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, or other defects. Equipment shall be secure in position and neat in appearance.

10.5 Testing and Commissioning

Each valve shall be test in presence of Engineer according to the manufacture pressure rating. Any kind of leakage from the valve is not acceptable. The valve shall be operate, by the Contractor, to demonstrate, to the satisfaction of the Engineer, that it is working, satisfactorily, in accordance with the specifications.

10.6 Measurement

Measurement for valve of specified type, materials, characteristics and dimensions will be made in the number of these items, acceptably installed, in accordance with the approved Drawings or directions of the Engineer.

10.7 Rates and Payment

10.7.1 Payment

Payment for valve, of specified type, materials, characteristics and dimensions will be made for their respective quantities, measured in accordance with Section 13.6, at the unit rates, tendered in the priced Bill of Quantities.

10.7.2 Rates

The unit rates tendered, for valve, shall be deemed to be inclusive of but not limited to the following:

Providing, installing complete valve, comprising main their support structure, painting/coating works; all fixing & installation accessories including bolts, nuts, washers, gasket, fittings, and leveling materials; and a complete set of special tools, test equipment and essential spare parts etc:

a. All sorts of transportation involved in the process
b. All sorts of wastages
c. Operations including injecting initial charges of lubricant and maintenance, protection and repairs, of the work
d. Carrying out designs and preparing shop drawings
e. Carrying out all sampling and testing
f. All other operations, procedures and requirements necessary to complete the work in accordance with these specifications

11.0 AREA LEVELLING AND GRADING

11.1 Description

a. The work to be done under this section consists of performing all earthwork, for bringing an area to the desired levels and grades, in accordance with these Specifications and in conformity with the lines, levels, grades and dimensions shown on the drawings or as directed by the Engineer.

b. Area levelling and grading works shall include the following:

   i. Performing the required excavations, in earth, rock or other materials, from the area, adjacent areas or from borrow areas
   ii. Transporting and disposal of unsuitable and/or surplus excavated materials
   iii. Transporting, placing and compacting the excavated materials in areas to be filled.
   iv. Final dressing of excavated and filled areas

c. All the provisions of Chapter 4.0 shall apply to this section of specifications.

11.2 General Requirements

a. Levelling and grading of the area shall be done, by means of leveling equipment and grading machines, to the lines, levels and grades as shown on the Drawings or established by the Engineer.

b. The Contractor shall be responsible for the required construction and stability of the grades and slopes of the area.

11.3 Excavation

11.3.1 General

a. No classification will be made for the excavated material, as to its class, nature, origin or conditions.

b. In the event, the Contractor excavates any area to a level, lower than the required, he shall fill the area and compact it to the satisfaction of the Engineer so as to bring the area to the required levels and grades and no extra payment will be made to the Contractor on this account.

11.3.2 Disposal of Surplus or Unsuitable Excavated Material

a. Suitable materials, obtained from excavations, shall be used for filling.

b. Any surplus or unsuitable material shall be disposed of by the Contractor, as directed by the Engineer.

11.4 Filling

a. Scarifying the Surfaces: Prior to placing first layer of filling, the existing and stripped surfaces shall, if so required by the Engineer, be scarified to a depth of not less than 150 mm (6") and the cost thereof shall be deemed to have been included in the rates for filling.

b. Filling Material: Areas requiring filling shall be filled with approved material, obtained from the excavations within the area to be graded, from roadway excavations or from borrow areas and all filling material shall be free from debris, tree roots, vegetative matter and such other objectionable substances.

c. Placing Fill Material: All filling shall be deposited in layers of thickness not greater than 300 mm (12"), and then compacted.

d. Compaction: Except where otherwise specified, each layer of the fill material shall be watered and compacted, with suitable equipment, to a minimum of 85% of the laboratory maximum dry density, based on AASHTO Test T180, Table D (Modified Proctor). The field density shall be determined in accordance with AASHTO T191.

14.5 Measurement

14.5.1 Excavation of Unsuitable or Surplus Material

a. Measurement, for excavation of unsuitable or surplus materials, for area grading works, will be made in the specified units, of theoretical volume of unclassified excavation, acceptably carried out, on the basis of the dimensions, for the neat excavation finish lines, in accordance with the Drawings or directions of the Engineer.

b. Only excavated materials, which are surplus to the requirements of the Project or are unsuitable, as established by the Engineer, will qualify for measurement and payments under this item. Excavation of materials, which are used for filling and other works, shall be deemed to be included in the pay items, relating to the parts of the work, where these materials are used.

14.5.2 Filling

Measurement, for filling, for area grading works, will be made in the specified units, of theoretical volume of compacted fill, of specified material and quality, acceptably placed, on the basis of the dimensions, for the neat finish lines, in accordance with the Drawings or directions of the Engineer.

14.6 Rate and Payment

14.6.1 Payment

Payment, for the above measured items, will be made for the respective quantities of these items, measured in accordance with Section 14.5, at the unit rates, tendered in the priced Bill of Quantities.

14.6.2 Rate

The unit rates tendered, for the above measured items, shall be deemed to be inclusive of, but not limited to the following:

a. <u>Common Applicable to All Items</u>
   i. All operations related with transportation, involved in the process
   ii. All operations related with storage of materials
   iii. All sorts of wastages
   iv. Operations including maintenance, protection and repairs, of the works
   v. Design, provision, construction, maintenance and removal of all the requisite temporary works like bridges and detours for the traffic
   vi. Design, provision, construction, maintenance and removal of the requisite public protection and warning works like suitable barricades, flood lights, warning lights, signs and similar items
   vii. Protection of existing adjacent facilities like paving, structures and utilities viiiMaking good all damages
   ix. Obtaining soil data and information
   x. Carrying out all sampling and testing
   xi. All other operations, procedures and requirements necessary to complete the work in accordance with these specifications.

b. <u>Excavation of Unsuitable or Surplus Material</u>
   i. Protection, preservation and maintenance of excavations
   ii. Stock piling of suitable excavated materials
   iii. Installation and removal of shoring, sheeting, wall bracings, planking, strutting and similar items
   iv. Dewatering for excavations, including works like drains, ditching, pumping, well-pointing, bailing, disposal and all other work
   v. Disposal of surplus and/or unsuitable excavated material and filth and garbage
   vi. Obtaining the consent of the Owner or tenant of the land, for disposal of surplus or unsuitable material.
   vii. Final finishing including grading, leveling, dressing and shaping of excavated surfaces

c. Embankment Formation
   i. Providing filling material including its excavation and transportation
   ii. Development of borrow areas including necessary clearing and grubbing, disposal of debris and other unsuitable materials, acquiring the necessary right-of-way for and making access roads, for hauling of materials and making provisions for the satisfactory drainage of the borrow areas
   iii. Scarifying the top soil layer, for receiving filling
   iv. All operations including placing, spreading, watering and compaction of fill materials
   v. Final finishing including grading, leveling, dressing and shaping of the filling surfaces

12.0 TESTS ON COMPLETION

12.1 General

This chapter describe specifications for Tests on Completion of the Project.

12.2 Contractor's Obligations

Surface water drainage facilities shall be provided to protect the buildings from surface run-off and to convey it away from the buildings.

The CONTRACTOR shall carry out the Tests on Completion.

The CONTRACTOR shall give to the EMPLOYER not less than 21 days' notice of the date after which the CONTRACTOR will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the EMPLOYER shall instruct.

Testing and commissioning period shall be 3 months. Unless otherwise stated in the Particular Conditions, the Tests on Completion shall be carried out in the following sequence:

a. pre-commissioning tests, which shall include the appropriate inspections and ("dry" or "cold") functional tests to demonstrate that each item of project/ scheme can safely under-take the next stage,
b. commissioning tests, which shall include the specified operational tests to demonstrate that the Works or Section can be operated safely and as specified, under all available operating conditions; and
c. trial operation, which shall demonstrate that the Works or Section perform reliably and in accordance with the Contract.

During trial operation, when the Works are operating under stable conditions, the CONTRACTOR shall give notice to the EMPLOYER that the Works are ready for any other Tests on Completion, including performance tests to demonstrate whether the Works conform with criteria specified in the EMPLOYER's Requirements and to the Performance Guarantees.

Trial operation shall not constitute a taking-over. Unless otherwise stated in the Particular Conditions, any product produced by the Works during trial operation shall be the property of the EMPLOYER.

In considering the results of the Tests on Completion, appropriate allowances shall be made for the effect of any use of the Works by the EMPLOYER on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed each of the Tests on Completion described in sub-paragraph a), b) or c), the CONTRACTOR shall submit a certified report of the results of these Tests to the EMPLOYER.

16.3 If the Tests on Completion are being unduly delayed

If the Tests on Completion are being unduly delayed by the CONTRACTOR, the EMPLOYER may:

a. by notice require the CONTRACTOR to carry out the Tests within 21 days after receiving the notice. The CONTRACTOR shall carry out the Tests on such day or days within that period as the CONTRACTOR may fix and of which he shall give notice to the EMPLOYER
b. If the CONTRACTOR fails to carry out the Tests on Completion; within the period of 21 days, the EMPLOYER's Personnel may proceed with the Tests at the risk and cost of the

CONTRACTOR. These Tests on Completion shall then be deemed to have been carried out in the presence of the CONTRACTOR and the results of the Tests shall be accepted as accurate.

12.4 Retesting If the Works fail to pass the Tests on Completion

Retesting If the Works, or a Section, fail to pass the Tests on Completion and the EMPLOYER or the CONTRACTOR may require the failed Tests and Tests on Completion on any related work, to be repeated under the same terms and conditions.

12.5 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated, the EMPLOYER shall be entitled to:

a. order further repetition of Tests on Completion;
b. if the failure deprives the EMPLOYER of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the EMPLOYER shall have the same remedies as are provided in Failure to Remedy Defects; or
c. issue a Taking-Over Certificate.

In the event of sub-paragraph (c), the CONTRACTOR shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the EMPLOYER as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the EMPLOYER may require the reduction to be

a. agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or
b. determined by arbitration, or
c. determined by the EMPLOYER.

13.0 OPERATIONS AND MAINTENANCE

13.1 General

Operator shall perform each of the services listed in this chapter as part of 'Operations and Maintenance'.

This chapter is based on Pakistan Engineering Council's (PEC) recommended document for 'Operations and Maintenance Contract', available at PEC's website.

13.2 Programs

In addition to those responsibilities described in the Agreement, Operator shall be responsible for the establishment and implementation of the following programs, standards and procedures, which require Owner approval and which are included in the "Services" to be provided by the Operator.

The program for establishing specific operating goals for each functional Project area, for managing resources to minimize personnel turnover, and for qualifying personnel, to operate and maintain the Project (including the basis for qualification of personnel).

The program for communicating and cooperating with Owner and governmental agencies.

The Project management standards for conduct of operations, Project safely, Project security conduct of maintenance, housekeeping, material condition, and records management.

The program for preparing supporting documentation, meter readings and information necessary to accurately prepare, justify and support monthly invoices in accordance with the terms and conditions of the Project Agreements.

Developing the procedures used to operate the Project as well as monitoring, evaluating, and proposing revisions to such procedures.

The Project operations and monitoring program which provides the requirements for:

a. Monitoring of Project Performance
b. Monthly Project Performance Calculations and Report
c. Monthly Fuel Consumption Calculations and Report
d. Project Permitting and Environmental Reporting
e. Shift Routines / Operating Practices
f. Control of Equipment
g. Project Chemistry Control and Water Treatment
h. Training Programs
i. Operator Qualifications
j. Operating Procedures
k. Status of Major Equipment

The maintenance program which provides the requirements for:

a. Maintenance Planning
b. Maintenance Procedures
c. Preventive Maintenance
d. Predictive Maintenance
e. Maintenance Training

The materials management program which provides the requirements for:

a. Procuring Materials and Tools
b. Inventory Levels and Control

c. Renewal of Inventories

The diagnostic testing program for maintaining the Project and Project equipment, including both system and component level testing.

The housekeeping / cleanliness program which provides the requirements for:

a. Hazardous Material Control
b. General Project Cleanliness
c. Equipment Condition Inspections
d. Hazardous Waste Program

The problem assessment program which provides the procedure for determining the cause(s) of operational or equipment failures and preventing future failures through recommended improvements, including justification for such recommendations (i.e., basis of recommendation and economic analysis).

The records management program for maintaining the traceability and documentation of Project performance.

The Project safety program which provides the requirements for establishing:

a. Safety Monitoring
b. Accident Prevention Program
c. Accident Reporting

Monthly and yearly reporting systems of Project performance to Owner.

The security program for maintaining the security of the Project and surrounding area.

13.3 Specific Requirements

Operator's scope of Services is based on the Project design as described in certain of the Project Agreements, the Project Operating Manuals, vendor manuals and design/ as built drawings. Operator will prepare Annual Project Operating Plans, which, in part, will define the operations procedural requirements for the Project to meet the requirements of the Project Agreements. Operator, as part of the Services, is responsible for:

Providing such trained personnel as is reasonably necessary to operate and maintain the Project and provide the Services set forth in this Agreement.

Operating and maintaining the Project in accordance with the approved Annual Project Operating Plan.

Submitting an Annual Project Operating Plan. Not later than ninety (90) days prior to the first day of each Contract Year, Operator will submit an Annual Project Operating Plan to Owner. The Annual Project Operating Plan will detail maintenance, outage, and overhaul schedules, Project staffing, known capital and expense budget items, operating plans, and will provide the underlying assumptions used in developing the proposed budgets and anticipated availability for the period. Owner will review and approve the Annual Project Operating Plan. Such approval will become the basis for reimbursement under the Annual Budget.

Planning and managing on-site operations and maintenance activities, including:

a. Assuring that operational goals and operating plans are consistent with the Annual Project Operating Plan.
b. Assuring that the Project is operated in accordance with this Agreement and in a safe, reliable, efficient, and prudent manner.
c. Assuring that operations and maintenance personnel are trained and qualified for their assigned responsibilities and tasks, and that such qualification is maintained.

d. Assuring that the Project meets contract, regulatory, and environmental requirements set forth in the Project Agreements or otherwise identified by Owner or Operator.
e. Managing and controlling costs consistent with budget requirements.
f. Planning, scheduling and managing work and maintenance activities.
g. Defining and documenting operational technical requirements.
h. Defining and delineating responsibilities between Operator and Owner and identifying reporting requirements.
i. Establishing labor relations and personnel programs that will meet state federal and provincial requirements and encourage employee retention.
j. Maintaining a current inventory of materials and procuring all services, spare parts, operational materials, consumables, office equipment, tools and shop equipment, or any other items or materials required to operate or maintain the Project. Operator will identify required items, cost, quantity and need date. The cost of any item or service shall be reimbursed by Owner in accordance with this Agreement.
k. Controlling outages, both planned and unplanned, by using detailed and integrated plans and schedules, and resource management.
l. Maintaining Project performance levels by using routine system and component performance testing.
m. Maintaining a file of pre-planned outage-related work to allow for efficient use of any forced outage downtime.
n. Establishing open purchase order or contract agreements with Project equipment vendors, industrial suppliers, jobbers, and maintenance CONTRACTORs in accordance with Project Agreements to ensure timely response to Project maintenance needs in compliance with public procurement rules.
o. Promptly notifying Owner in writing of any teardowns and overhauls of major equipment or capital improvements that Operator believes are necessary or advisable together with a proposed schedule for completing such repairs or improvements.
p. Performing such other tasks which Operator deems appropriate, from time to time, in connection with operation of the project.
q. Performing such other tasks and services which Owner may reasonably request from time to time in connection with operation of the Project.

14.0 POLYETHYLENE PIPELINES

14.1 Scope of Work

This chapter covers the laying, jointing and requirements for Polyethylene Pipelines and fittings for conveyance of sewage. The sizes are shown in drawings or specified in BOQ.

14.2 General

The High density polyethylene pipes shall have a full smooth circular section. The Pipes and fittings shall be made of food grade virgin high density PE plastic compound can also be classified by the material used PE-100.

Pipes and fittings of any identical material shall not be supplied by more than one manufacturer except with the approval of the ENGINEER.

They shall be of the class or grade having a factory or works internal hydraulic pressure test rating not less than the pressure rating as defined in the appropriate Standard Specification.

No pipes or fittings shall be ordered without the agreement of the ENGINEER.

14.3 Definitions

The following words and expressions shall have the meanings hereby assigned to them except where the context otherwise requires:

'Pipeline' shall have the definition assigned to it in CP 2010 and means a line of pipes having an appreciable length.

'Pipes' shall mean straight tubes having plain ends or ends shaped to form joints.

'Fittings' shall mean bends and similar items.

'internal' shall mean those parts of pipes or fittings which are to be in contact with the liquid being conveyed.

'Sewage' shall mean domestic wastewater.

'welding' mechanised Butt Fusion welding

14.4 Jointing Mechanism

One of the greatest features of HDPE pipes is the permanent jointing
Butt welding: This jointing technique is a very economical and reliable way for establishing permanent homogenous joints, requiring only butt welding equipment. Butt welding is particularly suitable for prefabricating pipe sections and special fittings. Only pipes and fittings from the same wall thickness series can be butt welded together.

14.5 Property of Polyethylene Pipes

Materials that are used in the production of polyethylene pipes and fittings components are classified by MRS. MRS is the value of durability that the material has against internal pressure under 20 ^{O}C for 50 years.

Table 14-1: MFR Classification of PE Materials.

RAW MATERIAL CLASS	MRS(MPa) VALUE
PE32	3.2
PE40	4.0
PE63	6.3
PE80	8.0
PE100	10

Safety factor according to the raw material class and the state of the line in PE pipe lines is determined and all calculations are made according to this factor. Safety factor is considered as C=2.0 in natural gas lines and C=1.25 in water supply pipe lines.

Table 14-2: C Coefficient Classification.

MATERIAL TYPE	C MİN
PB	1,25
PE	1,25
PP	1,6
PVC	2,0

As the density of the PE material rises, the value of mechanical endurance also rises. When a pipe that has the same operating pressure is made out of different raw materials, there is a decrease in the thickness of the pipe wall.

14.6 PE 100 PIPES

14.6.1 Technical Properties of HDPE 100 Pressure Pipes

Table 14-3: Technical Properties of Pressurized Pipes.

TECHNICAL PROPERTIES	UNIT	VALUE	TESTING METHOD
Density (23 OC)	g/cm3	0,950-0,960	ISO 1183
Melting Flow Rate (MFR)190 oC-2,16 Kg	g/10 min	0,04-0,07	ISO 1133
Melting Flow Rate (MFR)190 oC-5,0 Kg	g/10 min	0,2-0,5	ISO 1133
Breaking Elongation	%	>600	ISO 527-2/1B/50,TS 1398
Yield Stress Endurance	MPa	22-27	ISO 527-2/1B/50,TS 1398
Elasticity Module	MPa	950-1400	ISO 527-2/1B/50,TS 1398
Carbon Black Amount (190 oC-5,0Kg)	%	>2	ISO 6964
Hardness	Shore D	59-60	ISO 868
Thermal Endurance	min	>20	EN 728, ISO/TR 10837
Vicat Softening Temperature	OC	126	ISO 306(METOD A)
Brittleness Temperature	OC	<-70	ASTM D-746
Thermal Conductivity (20 OC)	W/mK	0,4	DIN 52612
Thermal Conductivity (150 OC)	W/mK	0,2	DIN 52612
ESRC (at 50 OC),F 50	hour	>10000	ASTM D-1693

14.6.2 Pressure-Temperature-Endurance Table of HDPE 100 Pipes

Pressure-temperature-endurance table of HDPE 100 pipes is given in Table 7-4.

Table 14-4: Pressure-temperature-endurance table of HDPE 100 pipes.

TEMPER. (OC)	WORKING LIFE (YEAR)	SDR								
		41	33	21	17	13,6	11	9	7,4	6
		PIPE SERIES S								
		20	16	10	8	6,3	5	4	3,2	2,5
		PN								
		4	5	8	10	12,5	16	20	25	32
10	5	5	6,3	10,1	12,6	15,7	20,2	25,2	31,5	40,4
	10	4,9	6,2	9,9	12,4	15,5	19,8	24,8	31,0	39,0
	25	4,8	6,0	9,6	12,1	15,1	19,3	24,2	30,2	38,7
	50	4,7	5,9	9,5	11,9	14,8	19,0	23,8	29,7	38,0
	100	4,6	5,8	9,3	11,6	14,6	18,7	23,3	29,2	37,4
20	5	4,2	5,3	8,4	10,6	13,2	16,9	21,2	26,5	33,9
	10	4,1	5,2	8,3	10,4	13,0	16,6	20,8	26,0	33,3
	25	4,0	5,0	8,1	10,1	12,7	16,2	20,3	25,4	32,5
	50	4,0	5,0	8,0	10,0	12,5	16,0	20,0	25,0	32,0
	100	3,9	4,9	7,8	9,8	12,2	15,7	19,6	24,5	31,4
30	5	3,6	4,5	7,2	9,0	11,2	14,4	18,0	22,5	28,0
	10	3,5	4,4	7,0	8,8	11,0	14,1	17,7	22,1	23,3
	25	3,4	4,3	6,9	8,6	10,8	13,8	17,2	21,6	27,6
	50	3,3	4,2	6,7	8,4	10,6	13,5	16,9	21,2	27,1
40	5	3,0	3,8	6,1	7,7	9,6	12,3	15,4	19,3	24,7
	10	3,0	3,8	6,0	7,6	9,5	12,1	15,2	19,0	24,3
	25	2,9	3,7	5,9	7,4	9,2	11,8	14,8	18,5	23,7
	50	2,9	3,6	5,8	7,2	9,1	11,6	14,5	18,2	23,3
50	5	2,6	3,3	5,3	6,7	8,3	10,7	13,4	16,7	21,4
	10	2,6	3,2	5,2	6,5	8,1	10,4	13,0	16,2	20,3
	15	2,3	2,9	4,7	5,9	7,4	9,5	11,5	14,8	19,0
60	5	1,9	2,4	3,8	4,8	6,0	7,7	9,7	21,1	15,5
70	2	1,5	1,5	3,1	3,9	4,9	6,2	7,8	9,8	12,5

14.6.3 Temperature-Related Endurance Diagram of HDPE 100 Pipes

Temperature-related endurance diagram of HDPE 100 pipes is given below.

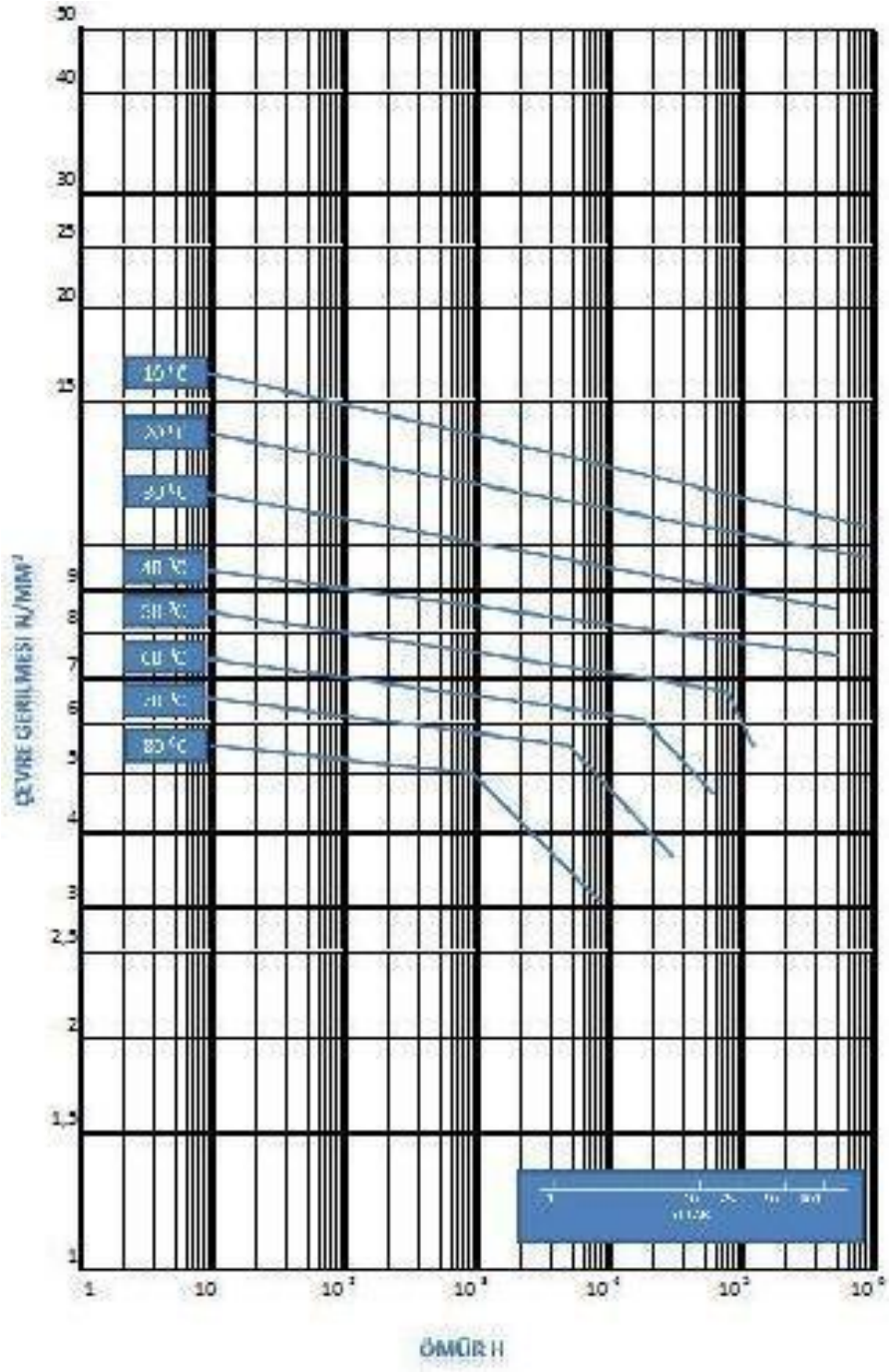

Figure 14-1: Temperature-related endurance diagram of HDPE 100 pipes.

14.7 Test Certificates

Each consignment of pipes and fittings delivered to the Site shall have been tested at the manufacturer's works or other approved place in accordance with the appropriate ASTM or BS or other approved standard (such test being referred to here as Works tests). The

CONTRACTOR shall provide the ENGINEER with the manufacturer's test report for each such consignment before delivery to Site begins.

The ENGINEER reserves the right to inspect the pipes and fittings to be supplied for the Works at the place of manufacturer and to witness works tests at all CONTRACTOR cost.

14.8 Marking

Pipe and tubing shall be marked in accordance with relevant standards, including IIP, UNI mark and reference to the Standard, nominal diameter, stiffness classes, material, area code, day/month/year of production. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided (1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, (2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and (3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261 or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

14.9 Workmanship

Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in colour, opacity, density, and other physical properties.

14.10 Laying and Jointing

All the pipes shall be examined for defects before lowering in the trenches. Defective or damage pipes shall not be used.

Pipe should be handled carefully so as not to damage them in any way. Any pipe damaged due to mishandling during pipes lowering, laying, jointing or at any other stage at site shall not be acceptable for use in permanent works. Laying and jointing of pipe shall be done in accordance with approved procedure keeping in view the integrity of pipes and joints. Adequate side support of acceptable nature shall be provided for the pipeline to keep the pipe at correct level and alignment. The width of excavated trench is as specified in the drawings but in any case it shall not be less than the minimum specified in ASTM D 2321.

Backfilling should be completed as soon as possible after pipe laying, and before the pipes are charged with water to avoid risk of pipes floating if trench is flooded during heavy rain. No pipe line shall or part thereof shall be covered up until all has been inspected by the ENGINEER or his representatives, but such inspection shall not relieve the CONTRACTOR from his responsibilities of delivering over the whole length of pipe line in a watertight, correct and perfect condition. The choice of the backfill material is very important.

14.11 Classes of Bedding Material

The classes of bedding to be used are indicated below:

Table 14-5: Classes of bedding.

Class of Bedding	Brief Description of Bedding Material
A (Deleted)	Mass concrete
A2 (Deleted)	Reinforced concrete
B (Deleted)	Granular material
S	Granular material (bed & surround)

Class S pipe bedding shall be constructed as indicated on the Drawings.
The granular material for use in Class S bedding shall consist of durable gravel, broken or crushed stone to the approval of the ENGINEER. Not more than 10% of such material shall pass a BS test sieve with 5 mm apertures and all the material shall pass BS test sieve having 14 mm apertures.

In clays, silts or fine sands and when ordered by the ENGINEER, one part of free draining sand shall be added to and well mixed with each two parts of the granular materials specified above. Alternatively, where approved by the ENGINEER, the granular materials may be 'all-in' gravel mixture of similar size or comprise a layer of coarse sand on the formation covered by granular material as specified. In all cases the sulphate and chloride content of the granular material shall not exceed 0.5% and 0.06% by weight respectively.

The granular material shall be evenly spread over the full width of the formation and lightly hand compacted to a level slightly higher than the level corresponding to the underside of the pipe barrel to allow for settlement of the pipe to the correct level.

Further granular material shall be placed in the trench, special care being taken to fill under the sides of the pipes to ensure full contact with the barrel of the pipe. The granular material shall then be compacted evenly on both sides and over the pipes to an overall thickness as shown on the Drawings.

The CONTRACTOR shall ensure that the material is adequately compacted, and the method of compaction used will be required to achieve not less than 90% of the modified Proctor maximum dry density as specified in BS 1377, Test 13.

Pipe cut-off structures as shown on the Drawings shall be constructed to limit the uninterrupted length of a granular bed to a maximum of 500 m, and the cost of this provision shall be deemed to be included in the granular bedding.

Where Cut-off structures arc not opposite pipeline markers, additional markers shall be placed opposite cut-off structures.

14.11.1 Granular Bedding for Pipes (Class B Bedding)

The CONTRACTOR shall lay the pipes on granular bedding where indicated on Drawings or directed by the ENGINEER. This bedding material shall consist of clean coarse sand or as specified by the ENGINEER or shown on drawings. Thickness of the bedding material below the pipe shall be as shown in the drawing and directed by the ENGINEER.

If the granular bedding material is contaminated by water, sewage or collapse of the sides of the trench, it shall be removed and replaced with new material before the pipes are laid or re-laid.

14.12 Sand Bedding Materials for HDPE Pipe & UPVC pipe

14.12.1 General:

All bedding and backfill material shall be free from boulders, cobbles, rock fragments, organic matter and debris.

14.12.2 Pipe Bedding

Bedding material shall conform to the following requirements:

14.12.2.1 Bedding Material:

Bedding material shall not contain boulders, cobbles, rock fragments, and organic matters.

The minimum depth of bedding material below the pipe shall be 100mm and minimum depth of overlay material above the pipe shall vary depending upon pipe material and size in accordance with the following table:

Table 14-6: Minimum depth of overlay material above the pipe.

Pipe Material	Overlay Material Depth	
	Dia. 100-450	Dia. 450-900 and above
HDPE Pipe	200mm	300mm

14.12.2.2 Compaction:

The degree of compaction of the trench fill material will vary from zone to zone and whether the trench is in a trafficable or non-trafficable area. The bedding material shall be placed in layers not more than 150mm thick and compacted by approved means to uniformly support the pipe and to achieve a uniform density throughout, whilst ensuring that the pipe is not damaged or distorted.

Trafficable Areas

The bedding material shall be compacted to achieve not less than 70% of the modified Proctor maximum dry density as specified in BS 1377, Test13.

Non-Trafficable Areas

The bedding material shall be compacted to achieve not less than 60% of the modified Proctor maximum dry density as specified in BS 1377, Test13.

14.12.2.3 Granular Bedding Material for HDPE pipe:

All granular bedding material shall be placed in layers not more than 150 mm thick and compacted by approved mechanical means. The Contractor shall ensure that the material is adequately compacted, and the method of compaction used will be required to achieve not less than 90% of the modified Proctor maximum dry density as specified in BS 1377, Test13. This material shall be well graded crushed stone/sand in conformance to gradation given in Table 18-7 below:

Table 14-7: Granular Bedding Material for HDPE pipe.

Sieve Size or Designation	Total Passing (Percent by Weight)
1/2”	100%
3/8”	85-100%
No.4	10-30%
No.8	0-10%

14.12.2.4 Backfill

The backfill material shall be placed and compacted in 150mm thick layers to achieve the required density uniformly throughout the depth of each layer.
Mechanical compaction directly above the pipe shall not commence until at least 200mm of cover is provided when using hand-held equipment or 300mm when using self-propelled equipment.

Trafficable Areas

The backfill material shall be compacted to achieve not less than 95% of the modified Proctor maximum dry density as specified in BS 1377, Test13.

Non-Trafficable Areas

The backfill material shall be compacted to achieve not less than 90% of the modified Proctor maximum dry density as specified in BS 1377, Test13.

14.12.3 Cover

All sewers and rising mains must be covered with sufficient earth or other insulation to prevent freezing.

14.12.4 Pressure and leakage testing

All types of installed pipe must be pressure tested and leakage tested in accordance with the appropriate AWWA Standards.

14.12.5 External Corrosion

a) Where external corrosion may be a concern, a system of records by which the nature and frequency of corrosion problems are recorded must be provided. On a plat map of the distribution system, show the location of each problem so that follow-up investigations and improvements can be made when a cluster of problems is identified.
b) If needed, perform a survey to determine the existence of facilities or installations that would provide the potential for stray, direct electric currents. Also, determine whether problems are caused by the use of water pipes as grounds for the electrical system.

c) In areas where aggressive soil conditions are suspect, or in areas where there are known aggressive soil conditions, analyses must be performed to determine the actual aggressiveness of the soil.
d) If soils are found to aggressive, take necessary action to protect the water main such as by encasement of the water main in polyethylene, provision of cathodic protection (in very severe instances), or using corrosion resistant water main materials.

14.12.6 Materials

14.12.6.1 Standards, materials selection

All materials including pipe, fittings, valves and fire hydrants must conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist. In the absence of such standards, materials meeting applicable Product Standards and acceptable to ENGINEER may be selected.

14.13 Transportation of Pipes and Fittings

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

Approved slings shall be used and all hooks and dogs and other metal devices shall be well padded. Hooks engaged on the inner wall surface at pipe ends shall not be used. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum.

Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the ENGINEER may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one another, be rolled freely or dragged along the ground.

14.14 Inspection of Pipes and Fittings

Transportation of pipes to Site over extremely rough terrain may give rise to a high proportion arriving damaged. Before incorporating into the pipeline each pipe shall be brushed out and carefully examined for soundless. Damaged pipes which in the opinion of the ENGINEER cannot be satisfactorily repaired, shall be rejected and removed from Site.

If under line test, the ENGINEER considers that an unacceptable proportion of the pipes within a test length has failed the CONTRACTOR may be required to test hydraulically to the Site test pressure each pipe and joint before pipe laying. In this event, test results shall be submitted to and approved by the ENGINEER before any further pipes are laid.

The cost of such individual pipe testing shall be borne by the CONTRACTOR.

14.15 Survey of the Pipeline Route

The CONTRACTOR in conjunction with the ENGINEER will set out and agree the final pipeline route and shall undertake a detailed survey of the agreed route prior to the commencement of construction work. The CONTRACTOR shall submit the results of the survey to the ENGINEER in the form of longitudinal sections drawn to a scale to be decided by the ENGINEER. They shall conform to the following:

(i) The length of the route shall be accurately measured and approved type Chainage markers fixed at 50 m intervals and clearly marked with the Chainage at that point.

(ii) Using modern survey equipment approved by the ENGINEER, ground levels shall be taken at intervals agreed with the ENGINEER. Generally a 25 m interval will be acceptable though this is to be reduced as necessary to ensure any abrupt changes in ground level are recorded.

(iii) Levels shall relate to an approved datum, and permanent bench marks shall be established, clear of the proposed pipeline, at intervals along the pipeline route.

The ENGINEER will review the pipeline profile and amend it where necessary including any revisions to the number and positions of air valves and washouts.

At all times the route surveying shall he sufficiently ahead of excavation and pipe laying by at least one further week's work to permit the ENGINEER's review to be carried out and revisions to be issued to the CONTRACTOR on the pipeline between high and low points on the section under construction and the next section to be opened up for construction.

14.16 Earthwork

In addition to the requirements of Chapter 4, the following sub-clauses shall apply:

14.16.1 Excavation

Where trenches for pipelines are constructed with vertical, sloping or stepped sides, that portion of the trench which extends from the formation level to not less than 2.0m above the crown of the pipe when laid in its correct position, shall, unless otherwise specified or ordered by the ENGINEER be formed with vertical sides the minimum practicable distance apart and shall be such that the distance between the side of the trench and the barrel of the pipe does not exceed 300 mm inclusive of any allowances required for temporary supports.

14.16.2 Backfilling

The excavation for pipelines shall be backfilled in two stages. Trench supports shall be withdrawn gradually in accordance with the progress of the fill subject at all times to the provision that such withdrawal will not prejudice the safety of the Works.

It is the CONTRACTOR's responsibility to provide suitable material for backfilling in accordance with the Specification.

a) First Stage

The pipe and pipe bedding or concrete surround (if any) shall be carefully covered leaving the joints exposed at the CONTRACTOR's discretion. Selected materials with particle size not exceeding 20 mm shall be evenly placed and compacted in layers not exceeding 100 mm thick after compaction.

The layers shall be compacted by hand controlled vibration on each side of the pipe only and not over the top of the pipe.

The backfill shall be compacted to achieve not less than 90% of the modified Proctor maximum dry density as specified in B. 1377, Test 13. This work shall commence as soon as possible after pipe laying and bedding is complete in the section or length concerned. Initially Site tests shall be made to prove the effectiveness of the method of compaction and thereafter at intervals of approximately 250 m.
Concrete bedding or surround (if any) shall be at least 72 hours old before backfilling commences.

b) Second Stage

After the section of pipeline concerned has passed the preliminary test, any holes left at exposed joints shall be filled and compacted to achieve not less than 90% maximum dry density as specified for the appropriate levels.
The remainder of the trench shall then be filled with excavated material with particle size not exceeding 100 mm evenly placed and compacted in layers not exceeding 200 mm thick after compaction. The method of compaction shall achieve not less than 90% maximum dry density as specified in BS 1377 Test 13.

This work shall be commenced and completed without delay.

14.17 Pipe laying

Pipe shall be laid in accordance with CP 2010 unless otherwise specified herein.

The pipeline shall be constructed in lengths with a separate full time gang working on each length. The work on the lengths may proceed concurrently. The programme for pipe laying shall be submitted to and be approved by the ENGINEER, at the start of the Contract. Any subsequent change in programme shall be submitted to and approved by the ENGINEER, before work to a different programme is started. Excavation for the pipeline in any one length shall not at any time proceed more than 2 km beyond the end of a tested, completed and backfilled length of pipeline unless otherwise approved by the ENGINEER. The exposed joints between test lengths shall be disregarded in the above definition.

No metal tools or heavy objects shall be permitted to come into contact with the pipes or fittings. Externally coated pipe shall be handled at all times with wide non-abrasive canvas, rubber or leather belts or other equipment designed to prevent damage to the coating. The use of chains, wire slings, or any other handling equipment found to be injurious to the coating shall not be permitted. The timbers or skids used to support the coated pipe prior to lowering into the trench shall be properly padded with sufficient bags stuffed with sand or straw for the purpose of protecting the coating.

Alternatively, the pipe may be supported alongside the trench on mounds of sand. Any injury to the protective coating from any cause must be repaired before the pipes are tested. Every precaution shall be taken to prevent foreign material from entering the pipes or fittings. During laying operations, no debris, tools, cloth or other material shall be placed in the pipe. Pipes and fittings shall be lowered into the trench with equipment suitable for the weight of the pipes and fittings, and in such a manner to ensure that the pipe is not laid in a stressed condition.

Pipe alignments shall be straight except at bends or when laid to curves.

The CONTRACTOR may submit to the ENGINEER for his approval an alternative method for the control of pipe laying to the correct levels and alignment, for example: on Non-controlled Sections as 1 m long properly graduated bubble level may be used to ensure minimum gradients and a measuring rod and cross straight edge used to determine minimum cover.

A 'badger' or 'bung' about 5 mm smaller than the internal diameter of the pipe shall be kept in the pipe of all times and pulled forward as the work progresses. When pipe laying is not in progress, including overnight, the open end of the pipeline shall be blanked off with a temporary watertight fitting approved by the ENGINEER. The pipe shall be suitably held down so that the pipe does not become buoyant in the event of the trench becoming flooded.

To restrict the flow of rain runoff along the trench the CONTRACTOR shall plug the trench with backfill material at distances not exceeding 250 m until the pipeline can be filled in. The plugs shall be removed when trench filling is taking place.

14.18 Pipe laying - Controlled and Non-Controlled Section

The criteria for the level and gradient to which pipes shall be laid are divided into two categories as follows:

'Controlled Sections' shall comprise the sections so designated on the Drawings, and such extra sections which shall be determined from the CONTRACTOR's detailed survey of the route, and approved by the ENGINEER.

'Non-controlled Sections' comprise the remaining sections of the pipeline where pipe gradients will normally correspond to ground slope and be subject to the following:

(i) The cover above the crown of the pipe to ground level shall normally be a minimum of 2.0m except where the pipe is in a situation requiring a greater depth of cover as shown on the Drawings.

(ii) The upward gradient shall be steeper as shown in drawings.

(iii) The position of high and low points shall be determined from the CONTRACTOR's detailed route survey and shall be as far apart as ground levels permit, with the depth of the pipe being increased from the minimum as per ground situations.

The CONTRACTOR shall ensure that the required pipe levels and gradients along 'Non-controlled Sections' comply with the above criteria. If after the route survey he considers that high or low points additional to those on the Drawings are essential the ENGINEER must be informed immediately. Failure to inform the ENGINEER of proposed variations may result in the CONTRACTOR being required to excavation to extra depths to avoid additional high points without any extra payment.

14.19 Laying to Curves

Lengths laid to curves shall only be allowed where shown on the Drawings or in accordance with detailed proposals approved by the ENGINEER.

14.20 Puddle and Thrust Flanges

Where a water barrier is required in the wall of a structure or a structure is required to take the thrust resulting from a pipe passing through it, a puddle or thrust flange or anchor ring shall be fitted as specified or indicated on the Drawings.

Thrust and anchor blocks on pipeline to be provided where indicated and as specified elsewhere in these specifications.

14.21 Pipeline Surrounded by Concrete

When pipework is surrounded by concrete at thrust blocks, anchor blocks, road and wadi crossings, etc the pipes shall be given the specified external protection approved by Site ENGINEER.

14.22 Pipework Built into Concrete

The external protection to pipes built into concrete walls of chambers and structures shall extend at least 75 mm in to the wall from the concrete face.

14.23 Washouts

The design and locations of washout are shown on the Drawings. Exact positioning shall be determined with regard to topography and be to the approval of the ENGINEER. At least 3m

of the washout pipework, inclusive for the isolating valve, measured from the centre line of the pipeline shall be laid at the same time as the pipeline and suitably capped to prevent ingress of foreign material. The minimum gradient for the washout pipework shall be 1 in 100.

Washout pipework shall be steel complying with ASTM A-53 Grade B Specification for high test line pipe, A-53 Grade B, having an outside diameter and minimum wall thickness as shown on the drawings.

14.24 Pipe Cleaning

Pipelines shall be manually cleaned of all debris, stones and sand prior to testing.
Before testing the mains on completion a foam swab shall be passed through the pipeline between adjacent swabbing points.

14.25 Testing - General

The CONTRACTOR shall carry out hydraulic test on the pipeline to detect lack of continuity or gross defects and to prove structural integrity in the pipeline section under test. This test may be carried out in sections as construction proceeds.

Unless otherwise specified or directed by the ENGINEER pipes of different materials in a pipeline shall be tested separately.

The CONTRACTOR shall supply all things necessary for carrying out the tests and shall be responsible for all work on the test site and for meeting all the requirements of all relevant regulations.

The hydraulic testing shall be carried out by an experienced specialist sub-contractor or specialist section of the CONTRACTOR's Organisation to the approval of the ENGINEER.

A Specialist Test ENGINEER shall be appointed by and specifically named by, the CONTRACTOR to be in full charge of all tests to be performed.

The Specialist Test ENGINEER shall prepare a schedule of operations for the tests stating the responsibilities of his subordinates during all phases of the work. The schedule shall include details of the following:

(a) Safety precautions to be observed during testing.

(b) The design and supply of any test fitting required.

(c) The locations of the test cabin, pumps, air compressors and any other equipment.

(d) Filling and pressurising, including sources of water, test connections and vent points.

(e) Hydraulic testing procedure.

(f) Depressurising and emptying and details of disposal of water.

(g) Fully detailed programme giving proposed dates of tests.

(h) List of nominated personnel supervising tests with dates and time of duty.

The schedule shall be submitted to the ENGINEER for approval at least 28 days prior to commencement of testing and written approval shall be given by the ENGINEER before any testing may commence.

14.26 Testing-Safety

The CONTRACTOR shall be responsible for all safely precautions and shall adequately protect all personnel on Site and the general public during the course of the tests.

Prior to testing the CONTRACTOR shall certify in writing to the ENGINEER that he has instructed all employees engaged on testing work, or any work associated with testing, of the possible consequences of a pipeline test fitting failure under pressure test conditions.

The CONTRACTOR shall ensure that no work is carried out on the pressurised sections during the period of the tests and during subsequent pressure reducing operations. If any work is essential on a section under test the pressure shall be reduced to a safe level to be approved by the ENGINEER before commencement.

No pressurisation shall be commenced without the approval of the ENGINEER.

The CONTRACTOR shall ensure that no person approaches within 100 m of the test end or section under test during the period of testing. If it is not possible owing to site restrictions for persons to avoid encroachment within this distance the CONTRACTOR shall provide suitable protective barriers. The CONTRACTOR shall also provide suitable barriers or walls for protection of property within 100 m of the section under test.

14.26.1 General

The CONTRACTOR shall supply all plant, equipment, fittings etc including gas, necessary for the hydraulic, tests. He shall submit to the ENGINEER, well in advance of the time for tests, details of his proposals for transporting the test water from the point of supply at the inlet works to the pipeline to be tested. No connections to the pipeline or pipework which would involve cutting, tapping or otherwise permanently altering the Permanent Works, will be allowed.

Test gauges shall be of approved manufacture having dials at least 200 nun diameter, graduated such that the test pressure is at least 75 % of the gauge reading. If necessary different gauges shall be supplied for different pipeline sections. Two gauges of each type shall be provided for the sole use of the ENGINEER and shall remain in the ENGINEER's possession for the duration of the Contract.

All gauges shall be dead weight tested and proved at the commencement of use and at regular intervals thereafter as required by the ENGINEER.

The CONTRACTOR's arrangements for testing shall include a suitable means of quick installation and removal of the ENGINEER's gauges during testing.

14.26.2 Test Pressures

The test pressure in any pipeline shall be 1.5 times the maximum working pressure, measured at the lowest point on the pipeline.

The CONTRACTOR shall submit a schedule of pipeline test pressures to the ENGINEER for approval prior to commencing testing.

14.26.3 Hydraulic Test

The sectional hydraulic test shall be carried out after the pipeline or pipework section to be tested has been laid, jointed and backfilled to a depth of at least 300 mm above the crown of the pipe but leaving the joints exposed. The sections to be tested shall be approved by the ENGINEER. The joints between each tested section shall then be left exposed until the pipeline has passed the Test on Completion.

14.27 Testing Structures on pipelines

Unless otherwise approved by the ENGINEER, water retaining structures on the pipelines which are not tested with the pipelines shall be separately tested in the presence of the ENGINEER for water tightness.

The structures shall be filled with water to ground level, the underside of the cover slab, or to give a head over the pipeline of 2 m whichever is the less. After a period to the approval of the ENGINEER to allow for absorption of water by the structure, there shall be no discernible loss of water over a period of 30 minutes as measures by a Vernier gauge or other approved device.

After depressurising the test section shall be carefully emptied and the water disposed of to the ENGINEER's approval.

14.28 Pipeline Markers

Marker Posts shall be of precast concrete Class A to the dimensions and locations shown on the Drawings, reinforced with 4 Nr 10 mm diameter high yield steel reinforcing bars tied to give 25 mm cover to each face.

Marker plates shall be 5 mm thick mild steel plate with dressed and bevelled face edges engraved to a depth of 2 mm x 3 mm x 150 mm mild steel fish tail plates shall be provided bent, split and welded to the back of the plate and the whole hot dip galvanised before casting into the marker post.

14.29 References

Following publications have been referred:

1. BS EN 13476-3:2007: Plastics piping systems for non – pressure underground drainage and sewerage.
2. ASTM D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique
3. ASTM D1603: Standard Test Method for Carbon Black Content in Olefin Plastics
4. ISO/DIS 18553 :Method for the assessment of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
5. ASTM D3895 : Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
6. ASTM D4019 : Standard Test Method for Moisture in Plastics by Coulometric Regeneration of Phosphorus Pentoxide
7. ASTM D2288 :Standard Test Method for Weight Loss of Plasticizers on Heating
8. ASTM D1238:Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
9. ISO 527-2 : Plastics -- Determination of tensile properties- Part 2: Test conditions for moulding and extrusion plastics
10. ISO 12091 : Structured-wall thermoplastics pipes -- Oven test
11. EN 1446: Plastics piping and ducting systems. Thermoplastics pipes. Determination of ring flexibility
12. EN 295-3: Vitrified clay pipes and fittings and pipe joints for drains and sewers. Test methods
13. ASTM D2122: Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
14. ASTM D2683: Standard Specification for Socket-Type Polyethylene

Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

15. ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

16. ASTM F1055:Standard Specification for Electro fusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

17. ASTM D2321:Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

15.0 ELECTRICAL GENERAL REQUIREMENTS

15.1 General

15.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work to provide complete electrical systems as specified in other chapters of the specifications.

15.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

15.1.3 Codes and Standards

In general, the electrical systems should use standard manufactured materials and equipment normally used in industrial facilities. This project's electrical systems should be designed in general compliance with the applicable portions of the following codes and standards, or equivalent as related:

1. ANSI (American National Standards Institute)
2. NEMA (National Electrical Manufacturers Assoc.)
3. National Electrical Code (NEC) - NFPA 70
4. Electrical Standard for Industrial Machinery (JIC) - NFPA 79
5. ICEA-IPCEA (Insulated Cable Engineers)
6. IEEE (Institute of Electrical and Electronics Engineers)
7. IET (Institute of Engineering and Technology) *formerly known as IEE*
8. IES (Illumination Engineers Society)
9. ISA (Instrument Society of America)
10. UL-Underwriter s Laboratories
11. Electricity Act of Pakistan
12. Applicable Local Codes

Except where otherwise specified materials shall comply with the standards and codes mentioned above, however, equivalent National or International Standard Specifications may be substituted at the sole discretion of the ENGINEER or as may have been agreed in the Contract. All standards used will be the current version at the time of bidding.

The CONTRACTOR shall obtain at least one copy of each IEEE, NEC, ANSI, ASME (American Society of Mechanical Engineers), CE (Conformité Européenne) or other approved standard and reference work which is referred to in the Specification, and of each other standard which applies to materials which are being supplied to, or workmanship executed on, the Works. These standards and reference works shall be supplied to the ENGINEER within 60 days of the ENGINEER's order to commence the Works and will be available to the CONTRACTOR at all reasonable times.

All materials and workmanship not fully specified herein or covered by an approved standard shall be of such kind as is used in first class work and suitable to the climate in the project area, for which ENGINEER’s decision is a binding.

15.1.4 Specifications

It is the intention of these specifications to fully cover all work and materials for a complete, first-class electric installation, and any devices such as pull boxes and disconnect switches, usually employed in the class of work, though not specifically mentioned in this specification, but which may be necessary for the satisfactory completion of the work, shall be furnished and installed by the CONTRACTOR as a part of his total work. Cooperate and coordinate with other CONTRACTORS to furnish complete workable systems.

In case of conflicting information on the drawings and/or in the specifications, the ENGINEER shall make the proper interpretation.

Carefully check space requirements to insure that equipment, pipes, conduits, etc. can be installed in the spaces allotted for them. Where interference occurs and work must be relocated, relocate without additional cost.

Changes and additions to scope of work under this contract shall be submitted to the ENGINEER and his written approval obtained before proceeding with the changed work.

During construction, the CONTRACTOR shall keep an accurate record of all deviations between the work as shown on the contract drawings and that which is actually installed. He shall secure a set of construction drawings for this purpose, and note changes thereon in red ink, in a neat and accurate manner, thus making a complete record of all changes and revisions in the original design, which exist in the completed work. The cost of furnishing above prints and preparing these record drawings shall be borne by the CONTRACTOR, and shall be included in the contract price. When all revisions have been shown on these prints to indicate the work as finally installed, the prints shall be delivered to the ENGINEER, before final payment.

15.1.5 Services, Inspection and Tests

CONTRACTOR shall show evidence that credible local service organization is in existence to service and furnish spare and replacement parts of all equipment.

The right is reserved to inspect and test any portion of the equipment during the progress of its installation. The CONTRACTOR shall test all wiring for continuity and ground before connecting any fixtures or devices. The CONTRACTOR shall test the entire system, when the work is finally completed, to insure that all portions are free from short circuits and grounds. All equipment necessary to conduct the above tests shall be furnished by the CONTRACTOR at its expense.

Secure and pay for all required permits and inspections. Inspection certificates from local authorities having jurisdiction shall be delivered to the EMPLOYER before final payment.

15.2 Products

15.2.1 Manufacturing Standards

Materials shall be new and approved and labeled by the UL or equivalent wherever standards have been established by that agency. Materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design. All items of the same type and rating shall be identical. Defective equipment or equipment damaged in the course of installation or testing shall be replaced or repaired in a manner meeting the approval of the ENGINEER.

15.2.2 Trade Names and Criteria and Substitutions

Manufacturers' names and catalog numbers indicated herein are not intended to be proprietary designations. They are used for convenience and indicate general type and quality of materials and equipment required. Equipment and materials by other manufacturers, which in the opinion of the ENGINEER are of equal quality and which will produce the same result with regard to both their ability to perform the required technical functions as well as to their appearance in the specific location on this project, will be considered.

Approval for equipment specified herein will not be given merely upon the submission of manufacturer's name. Notwithstanding, anything to be contrary in the specifications, approvals for equipment will be given only after the receipt of complete and satisfactory performance data in tabular and/or graphical form, as required by the ENGINEER. Complete and satisfactory information shall also be furnished relative to equipment dimensions, weight and other physical characteristics.

Wherever detailed operating features or a definite make and size of apparatus are specified, for which such quantities are readily determinable, the make and size of apparatus, which is

proposed for use, must conform substantially to the equipment specified. The same shall apply to important dimensions of the apparatus in relation to the rest of the system to properly fit it into the available space proposed by the CONTRACTOR. Any additional costs whatsoever that result from any approved substitution shall be borne by the CONTRACTOR.

15.2.3 Color Code

All cables, wiring and busbars shall comply with the following color code, including single core wiring, sleeves of mineral insulated metal sheathed cable, identification tape on the cores of paper insulated and similar cables and on short lengths of single core cable used to interconnect electrical apparatus:

1. TP, TPN, DC 2 wire, DC 3 wire, in accordance with Tables 51A and 51B of the IEE regulations (16th edition).
2. SPN - Main or sub-main cables, single core interconnections on switchgear and the like, busbars and risers - Red or Yellow or Blue, Black.
3. SPN - Final sub-circuit wiring - Red, Black (irrespective of phase).
4. All outdoor cables shall be marked permanently.

15.3 Execution

15.3.1 Schedule of Work

The schedule of the electrical work shall be arranged to suit the progress of the overall work. Cutting and patching shall be done in an approved manner. Cutting shall not endanger structural integrity or function of the building. Patching shall exactly match contiguous work. Costs of such cutting and patching shall be borne by the CONTRACTOR. Cutting shall be carefully done and damage to the building, piping, wiring or equipment, as a result of cutting, shall be repaired by skilled mechanics of trade involved. Cutting of masonry block and brick shall be done with masonry saw.

15.3.2 Labeling of Equipment

All motor disconnect switches, motor controllers, motor control center, panel board, transformer, etc., shall be identified by designation plates permanently attached thereto. All component parts of each item of equipment or device shall bear the manufacturer‘s nameplate, giving name of manufacturer, description, size, type, serial and model number and electrical characteristics in order to facilitate maintenance or replacement. The nameplate of a CONTRACTOR, SUBCONTRACTOR or distributor will not be acceptable.

15.3.3 Clearance from Other Services

Electrical services shall be kept at least 150 mm clear of water, steam, condensate and other mechanical services.

15.3.4 Wall Fixings and Steelwork Supports

The CONTRACTOR shall be responsible for installing all rag bolts, expansion shields, and the like and for all additional steelwork required for supporting cables, fuse gear, isolators, starters, lighting fittings and the like.

15.3.5 Painting

Paint all exposed conduit as well as cabinets and related items, etc. not supplied with a factory finish. Touch up all factory finishes damaged during installation or by adjacent construction work.

15.3.6 Outlets, Equipment Connection and Standards

Disconnect switches and power wiring, up to and including motor connections for all equipment provided under other Chapters of this specification, shall be included in this Chapter unless specifically excluded.

No conduit, outlet box, conduit stub-up, controller, etc. shall be installed until exact location has been determined by the coordinated effort of all SUBCONTRACTORS concerned. Any

relocating of outlet boxes, etc., or cutting or patching, which becomes necessary due to improper coordination between trades, shall be done at the CONTRACTOR'S expense.

Determine electrical requirements of other sections in order to fully understand wiring, and provide as required for the complete and satisfactory operation of the project. Make connections for other sections where indicated or required.

The CONTRACTOR will prepare the relevant Drawings and submit them to the ENGINEER for approval.

The CONTRACTOR will obtain approved shop drawings showing wiring diagrams, connection diagrams, rough-in and hook-up details, for all equipment from the ENGINEER and comply therewith.

15.3.7 Execution of related civil works

The CONTRACTOR shall execute all the related items for related civil/ builder's works items for the construction of foundations, making holes in the walls, making chases in walls/ floors and making them good etc. for the installation of E&M Equipment (like generators, pumps, motors and panels etc.). The CONTRACTOR shall undertake and execute all the relevant items for related civil/ builder's work complete in all respect to the approval of the ENGINEER.

Except where separately stated in the Bill of Quantities the cost of all civil works associated with any BOQ item of electrical works, such as excavation and backfilling of earth, compaction of the earth, foundation pads, thrust boring, chiseling, making openings, etc. shall deemed to be included in the price quoted against respective items. No separate payment for such works will be made. Such works will also include repair of any damage to civil works caused by the Contractor during electrical installation.

15.3.8 IP Degree of Protection

The equipment shall have IP degree of protection as follows, unless mentioned otherwise:

- IP 42 for indoor areas
- IP 54 for indoor damp areas
- IP 65 for outdoor areas

If properly rated equipment is not available, the Contractor shall provide field enclosures to attain the required IP degree of protection. If necessary cooling/exhaust fans and/or anti condensate heaters shall also be provided. No separate payment shall be made to attain the required IP degree of protection.

15.3.9 Replacement of inoperable lamps

All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance of the building by the ENGINEER/EMPLOYER.

16.0 BASIC ELECTRICAL MATERIALS AND METHODS

16.1 General

16.1.1 Summary

This chapter applies to all chapters related to all the “Electrical” work of this project’s specifications; including relevant materials & procedures; unless specified otherwise in the individual chapters.

Reference to any specific equipment or material does not necessarily imply that such material or equipment is to be included in the Works.

16.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

16.1.3 Definitions

The technical chapters referred to herein are those specification chapters that describe products, installation procedures, and equipment operations and that refer to this chapter for detailed description of submittal types.

16.1.4 General Requirements

Electrical materials and equipment should be specified to withstand the environmental conditions associated with raw/ clear water pumping stations with a normal life expectancy of 20 years.

All electrical connections, receptacles, etc. that have the potential to be negatively affected by moisture, dust, and extreme temperatures shall be protected as necessary.

The electrical systems should be designed to be cost and energy efficient, maintainable and operable.

16.1.5 Suppliers of Equipment

Before ordering material of any description intended for the Permanent Works, the CONTRACTOR shall submit for the approval of the ENGINEER the names of the maker or supplier proposed, a specification of the material and details of the place of origin or manufacture. If it is found necessary test regarding its compatibility with specifications be carried out at external facility. If requested by the ENGINEER the CONTRACTOR shall supply to the ENGINEER for his retention, a copy of any such order placed.

All materials used in the Permanent Works must be new, unless the use of old or refurbished material is expressly permitted by the Specification or the ENGINEER.

Materials used in the Works which are, or can be, in contact with the untreated or treated water shall not contain any matter which could impair taste, odour or toxicity or otherwise be harmful to health or adversely affect the water conveyed. Approval by bodies mentioned in Clause 3.1.3 will generally be regarded as satisfactory evidence of suitability.

16.1.6 Manufacturer’s Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's pre-printed data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

16.1.6.1 Drawings

Submit Drawings including wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

16.1.6.2 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

16.1.6.3 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical chapters. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

16.1.6.4 Testing Certificate

Submit a certificate that shall state that the item has been tested in accordance with the specified organization’s test methods and that the item complies with the specified organization’s reference standard.

16.1.6.5 Operating Instructions

Submit text of operating instruction manuals for each system and principal item of equipment.

16.1.7 Quality Assurance

16.1.7.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products, which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical chapter.

16.1.7.2 Service Support

The equipment items shall be supported by service organizations, which are reasonably convenient to the equipment installation, in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

16.1.7.3 Manufacturer’s Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number.

16.1.8 Posted Operating Instructions

Provide for each system and principal item of equipment as specified in the technical chapters for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
3. Safety Precautions
4. The procedure in the event of equipment failure.
5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

16.1.9 Labels, Notices & Nameplates

16.1.9.1 Nameplates

Provide nameplates for each panel board, switchboards, control panels, distribution fuse-boards, equipment, enclosure, relay, switch, and device; as specified in the technical chapters or as indicated on the drawings.

Characters shall be black on white where the function is to convey information and yellow on black where the function is to convey warning, as indicated elsewhere in this Specification.

16.1.9.2 Fixing

Fixing shall be by means of a minimum of two brass or chrome plated screws and nuts or self-tapping screws. Labels must be removable and fixings by means of rivets, adhesives, and the like will not be acceptable.

16.1.9.3 Labels

Labels shall be provided to indicate the following:

1. Reference number of each and every separate switch, fuse-switch, distribution fuse-board and the like.
2. Rating for switches, fuse-switches, and the like.
    a. Current or kW for contactors and the like.
    b. Number of fuse-ways and current rating for distribution fuse-boards.
3. Service – e.g. feeder or distribution system or equipment controlled for switches, fuse switches and the like.
    a. Equipment controlled for contactors and starters.
    b. Area served and the service (i.e. lighting, power and the like) for distribution fuse-boards.
4. Reference number of controlling switch, fuse switches and the like – this will apply generally to contactors and distribution fuse-boards.
5. Any other information called for elsewhere in this Specification.

16.1.9.4 Labels and Notices

Labels and notices shall be provided for:

1. Connections to an earth electrode or bonding conductor.
2. The intake point or metering position of each installation regarding periodic inspection.
3. The access point or points for apparatus installed at voltages exceeding low voltage.

4. Cables installed at voltages exceeding low voltage in any duct having access for personnel, inside any building, on any wall or structure, or suspended on any support. Notices shall be fixed where such cables emerge from the ground or from a duct, and on each side of any wall or partition through which the cable may pass and at intervals not exceeding 5m.
5. The access door or doors of every switch-room, switchgear cupboard or enclosure, generator house or similar electrical plant room.
6. Every item of apparatus, or enclosure, within which a voltage exceeding 250 volts exists and where the presence of such a voltage would not normally be expected.
7. Every item of apparatus, the operation of which requires special consideration, or may involve some risk to the operation or to others or which is interlocked with and/or operated in conjunction with other apparatus, or whose function is to act as a shutdown under given conditions. Such labels and notices shall give clear and unambiguous instructions as to the procedures to be followed, dangers involved and the like.
8. Every sub-station, walk-in switch-room, generator house or electrical plant room, giving instructions for the treatment or persons suffering from electrical shock. Detail of the notices shall be agreed with the ENGINEER.
9. Entry points of cables into buildings.

16.1.10 Polythene Cable Tags

Provide polythene cable tags where required.

16.1.11 Electrical Requirements

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, including control wiring and conduit for circuits rated 400 volts, to conform to the requirements of the chapter covering the mechanical equipment. The interconnecting power wiring and conduit, control wiring rated 400 volts and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided.
Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for lighting, receptacles, field-installed equipment, motor control equipment, motor control center assemblies, etc. Control wiring and conduit shall be provided under, and conform to the requirements of the chapter specifying the associated equipment.

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components as shown or specified.

16.1.12 Instruction to EMPLOYER'S Maintenance Personnel

Where specified in the technical chapters, furnish the services of competent instructors to give full instruction to the EMPLOYER'S designated personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the EMPLOYER for regular operation.

16.2 Execution

16.2.1 Painting of Equipment

16.2.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test (or equivalent) and the additional requirements specified in the technical specification chapters.

16.2.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

16.2.2 Spark Protection

All such metal items shall be configured, covered, protected, or made so as to present non-sparking surfaces. The supplier shall provide evidence of this protection to the ENGINEER and receive approval of their product before installation.

16.2.3 Safe Temperatures

All apparatus and conductors shall be of such construction as to operate at a safe temperature having regard to the conditions in which they shall be used and be so installed as to ensure that such temperature is not exceeded.

16.2.4 Electrical Grounding (Earthing) Requirements

Particular attention shall be paid to earthing. Earthing on power systems shall be in accordance with Electricity Act of Pakistan, or equivalent, and sensitive earth fault protection shall be employed at all sub-circuit or final sub-circuit boards or final sub-circuits where discrimination is necessary.

Earthing shall be made separately from main Earthing bar to all individual equipments.

16.2.5 Installation in Dangerous & Explosive Areas

Where installations are carried out in areas designated dangerous or hazardous, they shall be installed according to that Code of Practice as appropriate to the hazard classification and as directed by the Specification or the ENGINEER.

In all areas metalwork shall be galvanized. All equipment installed in hazardous areas shall be certified as complying with recognized safety standards. Installations shall be carried out in screwed heavy gauge solid drawn galvanized steel conduit. Alternatively thermoplastic or elastomer insulated, screen or armoured cable, with PVC, PCP or similar sheath overall may be used in conjunction with glands suitable for the area designation.

Accidental contact between flameproof apparatus, conduit or cables and pipe work shall be avoided.

16.2.6 Corrosion Protection

All exposed metal items, such as nuts, bolts, cables, supports, etc., must be made of an approved stainless steel for raw water applications. Internal piping must be an approved stainless steel for raw water applications or ductile iron Class 50. All ductile iron Class 50 components must be cleaned in accordance with the coating manufacturer's recommendations and painted with an epoxy coating approved for raw water use.

16.2.7 Humidity Protection

All electrical equipment, cabinets, switchboards and control boards shall be adequately protected from the effects of humidity. The CONTRACTOR shall fit anti-condensation heaters and/or forced ventilation to all items of equipment installed in locations subject to the effects of high humidity and condensation.

16.2.8 Access to Dangerous Voltage

All voltages in excess of 60 volts DC and 55 volts RMS AC between any two conductors of an un-earthed system or, where a system is earthed, between any conductor and earth, shall be considered dangerous to life and shall be treated accordingly.

All main switches specified herein shall be arranged with lock and key such that they can be locked in the 'OFF' position. All such necessary locks and keys shall be included in this Contract.

Any terminals that must normally remain live, such as the incoming terminals of main switches, shall be shrouded such that accidental contact at any time is not possible.

All removable covers to switchboards, terminal boxes, and the like shall be bolted on so that they cannot be opened by hand.

All such covers shall be labeled in block capitals with red lettering on white background in English and Urdu:

'DANGER ..... VOLTS'

Whether individually specified herein or not, all circuits shall be provided with isolating facilities such that each section and or part of the circuit can be disconnected and worked on safely at all times.

Fuses or other approved protective devices having a rated capacity based on the maximum current taken by the apparatus during normal operation shall be inserted in phase leads to each unit in a circuit. All fuses shall be readily replaceable without danger and any overload devices other than fuses shall be resettable without requiring entry into safety interlocked enclosure.

Notwithstanding the above, interlocking facilities shall be provided wherever safety requires that the contents of a cabinet or cubicle shall not be live when the enclosure doors are opened.

16.2.9 Interference Suppression

All electrical apparatus shall be suppressed to the satisfaction of the ENGINEER to minimize interference by power apparatus and circuits. Particular attention shall be given to items such as AC and DC machines. Suppression shall be effective at all radio frequencies.

Earth leakage current due to suppression equipment shall be restricted to 3.5 mA.

16.2.10 Spare Fuses and Miniature Circuit Breakers

Spare fuses and miniature circuit breakers shall be provided for each size and rating installed. The number of spares shall be agreed upon between the ENGINEER and the CONTRACTOR.

16.2.11 Wall Panels for Special Tools

All special tools for each item of plant shall be mounted on a suitable wall panel fixed as near as possible to that particular item of plant. None of these tools are to be used by the CONTRATOR, but shall be handed over complete in a new condition.

16.2.12 Solid State Equipment

Where solid state equipment is used it shall be adequately protected from atmospheric pollution and adequately cooled to a standard as required by the manufacturer of the equipment and to the approval of the Engineer.

All solid state equipment and its inter-connecting circuitry shall be screened to prevent electrical interference from other equipment, cabling or wiring.

Thyristor drives, if used, shall be protected from line voltage variations. Each thyristor unit shall be fitted with an individual semi-conductor protection fuse and trip indicator.

17.0 LOW VOLTAGE DISTRIBUTION

17.1 General

17.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work for low voltage distribution.

17.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

The CONTRACTOR shall submit with his design layout, drawings and dimensions of all items of switchgear offered, for approval by the ENGINEER.

17.2 Products

17.2.1 Low Voltage Switchboards

All switchboards shall be metal-clad, totally enclosed, extendable, unit or cubicle type and equipped as indicated in the specifications or approved on the Drawings.

Switchboards shall be ASTA certified (or equivalent) at the fault rating indicated elsewhere in this Specification. Where the fault rating is not specified or indicated, switchboards and panels energized through a circuit breaker shall be capable of carrying the through fault current equivalent to a fault level of 31 MVA with a peak making current of 2.55 times the symmetrical fault current at a power factor of 0.15 for a period of 3 seconds.

Switchboards and panels energized through HRC fuses, shall be capable of carrying for 0.2 seconds the above fault current with a peak making current of 2 times the symmetrical fault current at a power factor of 0.3.

Switchboards shall have a solidly continuous neutral and be equipped with HRC fuses, unless indicated elsewhere in this Specification.

The switchboards shall be floor standing or wall mounting as indicated elsewhere in this Specification, be rigidly constructed, with smooth external surfaces and have a minimum degree of protection classification IP 54 unless stated otherwise.

The switchboards shall be so designed and constructed as to permit the connection of additional cables and/or wiring to outgoing circuits in complete safety without de-energizing the whole switchboard or panel.

Switchboards shall provide effective segregation between incoming circuits/ busbars/ outgoing circuits/ control circuits and equipment. Where equipment is fitted above busbar chambers it shall not be possible for objects to fall into the chamber.

The segregation provided shall prevent the passage of ionized gas, resulting from the making or breaking or any circuit under normal or fault conditions, to any busbar, or adjacent switch.

Switchboards shall have vermin-proof drainage and ventilation holes as necessary, not exceed 2300 mm in height, unless stated otherwise and have operating handles and control devices located within the limit of 450 mm and 1950 mm above floor level. All cable entrances shall be from bottom, with proper cable gland.

17.2.1.1 Busbars

Busbars shall be of air insulated copper of constant cross section throughout with solid copper connections to outgoing switches and the like. The connections shall be as short and direct as possible and shall be air insulated except where insulated cable connections are a necessary design feature.

The busbars shall be rigidly clamped and secured to prevent undue movement under fault conditions or displacement as a result of the installation of cabling and be provided where necessary, with insulated phase or circuit barriers. Clamping and supporting bolts, screws and nuts, shall be of plated brass or steel.

17.2.1.2 Cable Glands and Terminations

Where the size and type of cables are indicated elsewhere in this Specification, then all necessary glands, spreader boxes and the like, shall be provided as part of the switchboard or panel by the manufacturer.

Where details of cables are not indicated removable plates shall be provided. For cubicle type switchboards and panels, sufficient gland plates shall be provided to cater for all future additions to the switchboard or panel, up to the maximum design capacity. The gland plates shall be so sized and arranged as to facilitate their removal for drilling for future additional cables.

Glands and terminals shall be so designed and constructed as to minimize the bending of cable cores.

Mains shall be provided as part of the switchboard or panel for securing these cores by means of clamps, trunking and the like. Cores shall not be run with busbars.

Where current transformers are called for, means shall be provided for properly securing these to the switchboard or panel proper. It will not be acceptable for current transformers to be fitted and secured to cable cores.

Terminations shall be made by sweated lugs, clamp connections or compression lugs.

Unless indicated elsewhere in this Specification, glands for paper-insulated cables shall be vertical, downward pointing, using where necessary, reverse entry boxes or adapters.

Auxiliary cables shall not be terminated in the same chamber as the main cables.

17.2.1.3 Earthing/ Grounding

Switchboards and panels shall have an earth bar to which all items of equipment shall be effectively bonded. This bar shall be of copper and shall be of the following minimum size:

Equipment with 3 second rating: 40 mm x 6.3 mm
Other equipment: 25 mm x 3 mm.

The earth bar shall be bolted to the main frame and located so as to facilitate the connection or protective conductors.

The metal sheaths and/ or armoring of all cables connected to the switchboard or panel shall be bonded to the earth bar by means of a separate protective conductor.

This conductor shall be a minimum size of 4 mm. All joints shall be tinned and bolted or clamped.

The frames of draw-out circuit breakers shall be earthed by means of a plug type contact sufficiently long to allow the shutters to close before contact is broken.

The star point of each group of current transformer secondary connections shall have a separate earthing link in an accessible position.

Neutral busbars shall be insulated from earth and, where necessary, shall have a cable gland and connection for an insulated single-core earthing conductor.

17.2.1.4 Current Transformers

Current transformers shall be fitted to the fixed portion of the equipment and suitable for the characteristics of the apparatus with which they are associated.

The transformers shall withstand safely and without damage the mechanical and thermal stresses set up by a short circuit equal to the full short circuit rating of the switchboard or panel and the effects of an open circuit in the secondary circuit with full load in the primary for a period of one minute.

Current transformers shall be secured in position using a method which does not exert undue pressure on the winding and shall have all secondary connections brought out to a terminal board by means of separate insulated leads. The leads shall be so arranged as to avoid the possibility of contact with any mains connection.

Labels shall show the polarity of primary and secondary windings and the duty or function of each transformer.

17.2.1.5 Indicating Instruments

Indicating Instruments shall be 'Industrial' grade, of robust construction, enclosed in dust-tight, flush mounting cases, will have 240° movement and maximum possible length of scale. Motor current ammeters shall have compressed or non-linear scales and a red line at normal full load current.

Ammeter scales shall be such that the normal full load current gives approximately 3/4 full scale deflection.

Meters shall have white faces with black markings, be moving-iron for ac circuits and moving coil for dc circuits, current transformers operated for ratings above 40 amps and where remote from the switchboard or panel.

Ammeters shall be capable of carrying full load current continuously, be suitable for operation with direct-on-line starting of motors where relevant and shall withstand without damage the passage of fault currents until operation of the main current protective device. Facilities shall be provided for zero adjustment without dismantling.

17.2.1.6 Locking Facilities

Locking facilities shall be provided in accordance with the following:

1. To enable all shutters to be locked in the closed position.
2. To enable each fuse switch, isolator and the like to be locked in the OFF position.
3. To enable each changeover switch to be locked in all positions.

Padlocks shall be non-ferrous and not smaller than 25 mm overall.
A minimum of 2 keys shall be provided with each lock or padlock.
Access doors to cubicle switchboards and panels shall have a lockable handle or padlock facilities.
Details of locks, keys, numbering and the like shall be confirmed with the ENGINEER before ordering.

17.2.1.7 Interlocks

Interlocks shall be provided to ensure that:

1. the cover of any fuse switch, isolator and the like cannot be opened with the switch closed;
2. any fuse switch, isolator and the like cannot be operated with the cover opened;
3. cubicle doors cannot be opened with the main isolator closed; and
4. The main isolator for any cubicle cannot be operated with the door open.

Note: Where it is impractical to comply with 3. and/ or 4., the equipment shall be fitted with a suitably worded warning notice.

The notice shall give instructions regarding the isolation of the equipment. Any equipment that is 'live' with the cubicle doors open shall be fully shrouded and fitted with a warning notice.

17.2.1.8 Small Wiring

Small wiring shall:

1. be not less than 1.0 mm, multi-stranded, black PVC as specified for Control Cables;
2. be grouped, as far as is practicable, according to the circuits involved;
3. be run in insulated cleats, plastic or steel conduit or trunking;
4. be terminated with clamp washers or crimped terminals;
5. have a numbered ferrule or sleeve at each end of each wire – the numbering shall
6. be in accordance with the wiring diagram;
7. be run between terminal points – joints will not be permitted;
8. be provided with fuses and links to enable all circuits to be isolated from any bus wires;
9. be so designed and installed as to permit maintenance and test work to be carried out without de-energizing the whole switchboard or panel;
10. Incorporate terminal boards having stud or clamp type connections – pinch screws will not be accepted;
11. be connected at the front of terminal boards;
12. be clearly identified and marked where it may be alive when the main circuit isolator is open;
13. be segregated, where relevant; and
14. Have a terminal for all spare wires and spare cores of multi-core cables.

17.2.1.9 Painting & Protection

Anti-corrosion treatment and painting shall be in accordance with the following:

1. Sheet steel shall be zinc-coated, rust-proofed.
2. Before dispatch from the manufacturer's works all equipment shall be painted with rustproof primer, filled and flattened, painted with 2 undercoats and a minimum of 2 finish coats of semi-gloss finishing paint to an approved color. Where a manufacturer proposes an alternative paint system, the approval of the ENGINEER must be obtained in writing before any work is put in hand.
3. Switchboards and Panels shall comply with this Specification for: Fuses; Miniature Circuit Breakers; Moulded Case Circuit Breakers; Distribution Fuse-boards; Fuse switches, Switch fuses and Isolators; Labeling; Contactors; Transformers; Motor Starters and Controllers.

17.2.2 Low Voltage Distribution Boards

All low voltage distribution boards shall be of fabricated sheet metal construction, fully rust-proofed, painted to an approved finish and protected against ingress of solid foreign bodies and liquid. All boards shall be rated as required.

They shall be arranged for conduit and/or cable entry as required and all boards shall be supplied complete with HRC cartridge fuses or miniature circuit breakers.

All low voltage distribution boards shall have banks of fuses or miniature circuit breakers that are easily removable and readily accessible for easy wiring. All boards shall have 25% spare ways fitted within the case.

Any boards that have feeders looped in or out at the busbars shall have double terminal blocks on each busbar.

All boards shall have insulating barriers installed between phases and between each phase and earth.

Where boards are fixed on steelwork or concrete columns, reinforced concrete or brick walls, they shall be mounted on the surface with conduits and/or trunking rising vertically from them.

Where boards are fixed on plaster finished walls, they shall be surface mounted on the finished face of the plaster with an adaptable galvanised metal box (minimum size 150 x 150 x 75 mm), recessed into the wall at the back of each board. Suitable holes or slots shall be cut in the back of the board to accommodate all incoming and outgoing cabling, these holes and slots being suitably bushed by sleeving. The adaptable box and fuse-board shall be separately fixed on the wall but electrically and mechanically linked together and the boards independently fixed on the wall by bolts and expansion shields.

Boards shall be mounted in positions finally agreed with the ENGINEER on site.

Distribution boards shall be fitted with a permanent label giving details of fuses or miniature circuit breakers when the use of equipment of other makes or types would adversely affect the protection or discrimination provided.

17.2.3 Miniature and Moulded Case Circuit Breakers

Miniature circuit breakers shall be of the suitable ratings.

The effect of ambient temperatures, operating duty and application shall be fully considered in applying de-rating factors for application at site.

Miniature and Moulded case circuit breakers shall have means for preventing any one pole of a multi-pole circuit breaker being operated or tripping independently of the other poles.

Miniature and Moulded case circuit breakers shall have locking facilities and be supplied with all keys, or shall be enclosed in cases with locking facilities which shall be provided with keys.

Miniature and Moulded case circuit breakers shall be of the same type throughout the Contract.

17.2.4 Residual Current Circuit Breakers

Residual current operated devices are to be either 3 phase and neutral or 1 phase and neutral.

Both types will be of the circuit current rating and rated tripping current as stated elsewhere in this Specification. Either type must isolate all poles and neutral and be complete with a test button marked ‘PUSH TO TEST’. The unit must be of robust construction and be mounted in an enclosure of pressed steel.

Where residual current circuit breakers are used they shall be of the AC/ DC current-operated type when incorporated in fixed socket outlets, except that they shall be suitable for the service conditions as defined at site.

17.3 Execution

17.3.1 General Requirements

All low voltage fuse switchgear shall be metal clad, fully dust-proofed, painted to an approved finish and protected against ingress of solid foreign bodies and liquid. Where switchgear is exposed to weather, it must be completely watertight. All units are to be suitable for cable or conduit entry as required.

All isolators and fuse switch units shall be complete with "ON/OFF" padlocking facilities, including padlocks and keys. Where complete safety can be assured only by making dead a system inside a cubicle or cabinet, the doors of the cabinet or cubicle shall have interlocking facilities so that the act of opening a door removes power from the contents of the cabinet or cubicle.

All live metal parts shall be fully surrounded between phases and from each phase to earth by Moulded shrouds.

All low voltage fuse switches shall be load breaking, 'fault making' and each shall have a proved rupturing capacity of not less than 31 MVA at 415 volts. All switchboards shall be of the heavy duty industrial type, metal clad, floor standing or wall mounting as required, and as approved by the ENGINEER, fully rust-proofed and waterproofed where exposed to weather, with isolators and fuse switchgear units mounted thereon and complete with all necessary interconnections. All fuse switchgear shall carry short-circuit rating test certification.

All low voltage fuse switches and isolators shall have ratings adequate for the duty as detailed in this Specification and shall be suitable for conduit entry or fitted with cable boxes and/or glands as required.

18.0 CONDUCTORS & CABLES

18.1 General

18.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work to provide a complete system of conductors as indicated or necessary to accomplish the required connections. All conductors shall be installed in a neat and workmanlike manner, with care being taken that conductors are not kinked, scarred, or damaged during installation.

18.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

18.2 Products

18.2.1 Conductors and Insulation

Wire and cable shall be soft drawn, annealed copper with 600-volt insulation. Aluminum wire will not be accepted.

Conductor insulation shall be type THWN, THHN or XHHW.

The voltage drop at the end of any circuit shall not exceed 3% of the normal line voltage under full load.

18.2.2 Cables Run above ground

Cables run above ground shall be secured to walls, structures or cable trays by means of plastic or aluminum alloy cleats. The cleats shall be of one or two bolt type and correctly sized for the overall diameter of the cable. They shall be of the type that can be built up into multi-cable assemblies.

Cables shall be secured in accordance with the following:

1. Single multi-core cable; single cleat cable up to 25 mm diameter, fixed with brass woodscrews to brickwork and the like.
2. Single multi-core cable; single cleat cable above 25 mm diameter. Fixed using expansion bolts and sheradized or galvanized studs and nuts.
3. Multi-cable runs of multi-core cables; fixed to brickwork via galvanized proprietary back-strap or via galvanized channel with cleats fixed by means of galvanized or sheradized studs and nuts. The back-strap or channel shall be sized to permit the addition of at least 25% additional cables.
4. Multi-core cables; fixed to galvanized cable tray via sheradized bolts and nuts.
5. Single core cables; as agreed with the ENGINEER.

Multi-cable assemblies shall be arranged so that a minimum space of 20 mm is maintained between any cable and any other cable or any wall, cable tray or other surface.

Where cables enter through walls and floors cables shall be sealed with approved fire-resisting cable transits. Where cables pass through a floor at a position where they may be subject to mechanical damage they shall be protected to a height of 1800 mm by means of steel pipe work or galvanized sheet steel or such other method as may be approved by the ENGINEER.

18.2.3 Cables laid in the ground

18.2.3.1 General

Cable trenches shall be prepared such that the cable minimum bending radii are not reduced during cable installation.

Cables shall be segregated into the following categories:

1. power (greater than 1000 V)
2. power (less than 1000 V)
3. instrumentation/telemetry
4. control
5. telecommunications

Cables shall be laid in a manner such that any electrical interference between cables shall not have a detrimental effect on the life and operation of equipment installed within the installation. As a general rule there shall be a minimum separation of 600 mm between HV power and all other cables and 300 mm between LV power and all other cables. Instrumentation, control and telecommunications cables shall be laid together in PVC-U duct of minimum diameter 100 mm.

These separations are minimum and special circumstances such as the presence of high current flows, or harmonic content may necessitate larger separation distances. Buried cable up to 1000 V shall have a minimum cover of 500 mm measured to the top of the highest cable. On crossing roadways the cable shall be run through a PVC-U duct of minimum diameter 100 mm with a minimum of 1000 mm cover and encased on all sides by 150 mm of Class 20/20 concrete.

Higher voltage cables shall be buried with a minimum cover of 1000 mm.

Where, for any reason, the minimum specified cover cannot be provided the cables shall be run in cable ducts encased on all sides by 150 mm of Class 20/20 concrete.

18.2.3.2 Cables Installed Direct in Ground

Installation of cables direct in the ground shall be in accordance with the Standard Details. The bottom of the trench shall be free of sharp stones and the like.

Protective covers shall be interlocking clay or concrete cable tiles not less than 100 mm wide and clearly and indelibly marked ‘DANGER ELECTRICITY’.

Warning tape shall be run in one or more continuous strips and laid so as to provide adequate cover to the cables. It shall be red and shall be clearly and indelibly marked ‘DANGER ELECTRIC CABLES’.

The graded backfill above the sand shall be free from boulders and other sharp, deleterious material.

18.2.3.3 Cables Installed in Ducts

1. Underground ducts shall be of 100 mm diameter (minimum) impact resistant PVC-U.
2. They shall be laid with a minimum cover of 500 mm and surrounded by at least 75 mm of sieved sand.
3. At all road crossings, where the minimum cover shall be 1000 mm, and elsewhere where the specified minimum cover to buried cables cannot be provided, 100 mm diameter (minimum) PVC-U ducts shall be installed and encased on all sides by 150 mm of Class 20/20 concrete.
4. Cable draw pits shall be provided at a maximum spacing of 25 m and at all changes of direction. Nylon drawstrings of sufficient size shall be provided in all ducts to allow additional cables to be installed as required.
5. All ducts, whether containing a cable or not, shall be sealed at each end. Conduits into buildings shall be sand filled and sealed at each end by hot poured bitumen compound.
6. For situations subject to high water table or high water pressure, or in tanked buildings, multi-cable transits shall be installed. Ducts under roadways and the like shall be sealed by weak mortar.
7. Cables shall be identified at each end using permanent plastic labels secured using two bindings per label. The identification shall show a reference number, conductor size, number of cores and material, if not copper.

18.2.4 Cable Markers

Cable markers shall be installed to indicate the position of underground cable(s).
Cable markers shall be installed in accordance with the following:

1. at each side of each road crossing;
2. at every change of direction;
3. at each point where cable(s) enter or pass under a building or structure, at 300 mm above ground level;
4. at each joint authorized by the ENGINEER;
5. at intervals not exceeding 45 m on straight runs.

18.2.5 Wiring to Lighting and General Power Circuits

Wiring to lighting circuits shall (unless indicated otherwise):

1. Be of one of the following sizes: 1.5 mm single core PVC except for circuits loaded above 1 kW where 2.5 mm shall be used, but 1.5 mm and 2.5 mm cables shall not be used in combination on the same circuits; 1.0 mm light duty multi-core mineral insulated, metal sheathed.
2. Where carried out in single core cables in conduit, be installed on the 'loop-in' principle, no joints or junction boxes being permitted. Line conductors shall be looped at switches. Neutral conductors shall be looped at lighting points.
3. Cables shall be drawn into a conduit simultaneously without twists. Cables bunched into circular groups shall have the appropriate de-rating factor applied.
4. Where carried out in multi-core cable, have the line and neutral conductors looped at the lighting point.
5. Not be looped at terminal blocks internal to lighting luminaries. For fluorescent or similar luminaries having internal terminal blocks, the fixed wiring shall terminate at the conduit box with tails taken into the fitting. The arrangement shall be such that the fittings and tails may be removed without causing the other lighting luminaries on the circuit to be disconnected.
6. Wiring to 13 A socket outlet circuits shall be ring wired throughout. Spur circuits shall be used only where specified.

18.2.6 PVC Insulated PVC Sheathed Cables

PVC insulated PVC sheathed cables shall be 1000 volt grade with copper conductors and incorporate an earth continuity conductor.
Where run in timber floors or roof voids, they shall be run either along the timber joists or at right angles to them.

When run in intermediate floors and at right angles to the joists, they shall be threaded through maximum 25 mm diameter holes, drilled at half joist depth.

When run in roof voids or underground floors, and at right angles to the joists, but not threaded through holes, i.e. clipped across the top of roof joists or clipped to the underside of floor joists, they shall be protected as necessary.

All drops to switches, socket outlets, and the like, shall be truly vertical, and when concealed by plaster, they shall be protected by galvanized channel. All cables shall be well fixed by cable clips, and for surface work these shall not be more than 225 mm apart.

On PVC insulated and PVC sheathed cable systems all lighting luminaries shall be mounted on conduit boxes securely fixed to timber battens, the battens being supplied and installed by others in positions indicated by the CONTRACTOR.

Cables to all tungsten lighting fittings shall terminate via heat resisting flexibles of high temperature glass, PTFE or other approved insulation.

Cables to all fluorescent lighting fittings shall terminate via high temperature PVC singles or other approved insulation.

In all cases the connection to the PVC insulated PVC sheathed main wiring system shall be by two screws, porcelain insulated brass connectors within the conduit box.

18.2.7 PVC Insulated Cables

1. Where wiring is in conduit and/or trunking it shall be installed using single core PVC insulated 1000 volt grade cables, and shall consist of high conductivity stranded copper conductors. On single phase circuits phase conductors shall be red, neutral conductors shall be black.
2. On three phase circuits the colors shall be red, yellow and blue, with black for neutral.
3. A separate circuit protective conductor shall be installed for each circuit with insulation colored green and yellow.
4. Cable shall be delivered to site on reels with seals and labels intact, and shall be of one manufacturer throughout the installation. Minimum conductor size shall be 1.5 mm.
5. As far as is practicable all cables shall be threaded rather than drawn into the conduit, the CONTRACTOR shall provide himself with suitable reels to prevent contact of the cables with floor and to prevent chafing or other accidental damage.
6. In the event of any protective insulation being damaged whilst cables are being threaded into conduit the whole of the particular length concerned must be replaced and re-fixed by the CONTRACTOR at his own expense.
7. The wiring of lighting and socket outlet systems shall be carried out on the 'loop in' system, all cables shall be continuous between definite terminal points, and joints in cables will not be permitted.
8. All connections shall be made in the terminals of ceiling roses, switches, switch sockets, or other termination boxes using approved pattern porcelain insulated brass connectors within the conduit boxes. PVC terminal block type connectors with grub screws shall not be used.
9. For butyl cables, the tape and braid shall be stripped back 10 mm from the connection.
10. Extra low voltage and communication cables shall not be run in the same trunking or conduit as low voltage cables. PVC cables shall not pass through or terminate in lighting luminaries.
11. All cables, except where otherwise stated, in this Specification, shall be threaded into the conduit, after erection, without undue tension. The CONTRACTOR may be required to withdraw cables contained in certain conduits at sundry selected points to demonstrate that these requirements have been complied with.
12. Cables shall be drawn into a conduit simultaneously without twists. Cables bunched into circular groups shall have the appropriate de-rating factor.
13. Cables shall not be drawn into trunking but laid in, necessitating, the removal of all trunking lids. This is to apply when new cables are being installed and/or existing cables are being renewed.

18.2.8 Flexible Cords

All flexible cords to be used in conjunction with lighting luminaries shall be white 3 core circular 300/500 volt grade PVC insulated and sheathed manufactured to BS 6500.

Conductors smaller than 0.75 mm shall not be used unless previously approved by the ENGINEER.

18.2.9 Voltage Drop

In addition to observing the above minima the CONTRACTOR shall ensure that all sub-circuit cable sizes are so selected that the total voltage drop does not exceed the limits stated in IEEE Regulations.

In considering the volt drop requirements of motor circuits due allowance shall be made for the effect of starting current on the motor terminal voltage and starting torque.

18.2.10 Control Cables and Cabling

Control cabling shall be carried out in 600 volt grade, circular multi-core cable, PVC insulated, single wire armoured and PVC sheathed overall, having a minimum conductor cross-sectional area of 1.5 mm. Cable terminations shall be made in approved type compression glands with armour clamps, PVC shrouds and earthing tags.

Each control cable shall have 25% spare cores to allow for any later additional requirements. Conductors shall be of stranded copper complying with BS 6360.

Marshalling boxes shall be provided as required for control cable connections. They shall be of sufficient size to accommodate all spare cores entering the box. Terminals shall be provided within the boxes sufficient to ensure that no more than one core is terminated at any terminal. Boxes shall allow a minimum clearance of 150 mm between terminal rails and the box sides and 100 mm between adjacent terminal rails. Each terminal in the marshalling box shall be identified in accordance with the relevant schematic or wiring diagram. Boxes shall be protected to IP 65.

18.2.11 Tests on Cables

Manufacturers' tests shall be carried out including conductor resistance and ac voltage tests. Manufacturers' test certificates for all cables shall be submitted to the ENGINEER for approval.

18.2.12 Joints and Terminations

Leave at least 6 inches of free conductor in each outlet or junction-box for making up joints and making connections to fixtures, devices or equipment.

18.3 Execution

18.3.1 Conductor Installation

1. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes shall be provided where required. Home runs may be combined in one conduit, provided all connections are in accordance with NEC requirements and the maximum unbalanced current in the neutral does not exceed the capacity of the conductor. All parallel feeder runs shall be laid out and cut to exact same lengths before pulling into conduits to insure load balance. No additional trimming of parallel conductors will be accepted. Conductors shall be pulled by hand and without aid of block and tackle or other mechanical device. Only approved pulling compounds, which will in no way damage the insulation on the conductors or hasten its aging, may be used to facilitate pulling of wire into conduit. Circuiting shown shall be followed unless specific changes are approved by the ENGINEER.
2. Balance circuits across phase wires of the branch and distribution panels.
3. Switches shall not be connected to the neutral conductor.
4. Where several feeders pass through a common pull box or junction box, the feeders shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation. Paint this same information on the cover of the box.
5. Wherever cable minimum sizes and/or ratings are stated in the Specification, it is the CONTRACTOR'S responsibility to increase the rated size of any cable above the figures given should he, for any reason, consider such increase essential, whether to provide voltage drops within those stipulated in the IEEE Regulations, to comply with short circuit ratings, fault levels, or for any other reason.
6. The CONTRACTOR shall also be responsible for any cable capacity de-rating necessary because of the climatic conditions on site. The CONTRACTOR shall assess the actual length of any route and make all necessary allowances for bends, rises and falls, connections, and the like and apply any other de-rating factors necessary to prevent over-heating.
7. The CONTRACTOR shall provide and install any ancillary supporting steelwork, cable trays, or brackets, necessary to support, in accordance with the best current

practice, all cables, conduits, trunking and lighting luminaries. This applies to all systems.

8. Where cables pass through floors or rise vertically up walls or structural steelwork, and the like, they shall be protected by passage through mild steel pipes to at least 1 m above floor level or to the underside of the dividing box, whichever is less. Cable slots or holes made in floors shall be provided either with a mild steel pipe or a concrete surround rising 75 mm above finished floor level.
9. The exits of all such pipes shall be properly sealed against water entry.
10. As far as possible, cables shall be routed along common multi-cable runs. If trays are provided they shall be supported by brackets. Purpose-made bends, tees and angled tray material shall be used where necessary.
11. Wherever cable trays are used, they shall be secured to the walls of the building structures by means of angle brackets spaced at intervals of not more than 1200 mm or by angle suspenders from the ceilings at the same intervals. The fixing bolts which secure the brackets to the walls or underside of floor shall be of not less than 10 mm diameter.

12. The CONTRACTOR shall provide, fix and connect all cable saddles, cleats and brackets. All supporting steelwork shall be painted as specified.
13. All cables should be securely fixed to the tray. Where cables do not run in multi-cable runs they shall be fixed to walls by suitable cable cleats. The maximum spacing of cable cleats, saddles, and the like shall not exceed 610 mm in horizontal, or 810 mm in the vertical plane.
14. All manufactured supporting and fixing materials shall be hot dipped galvanized and all purpose-made and site fabricated steelwork shall be painted as specified. Fabricated brackets shall, wherever possible, be welded in preference to the use of bolts.
15. The CONTRACTOR shall be responsible for all off-loading and handling of cables on site and shall ensure that cables are delivered to site on drums properly protected against mechanical damage.

19.0 ELECTRICAL GROUND SYSTEM

19.1 General

19.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work for electrical ground systems (or earthing) systems.

19.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

19.2 Products

19.2.1 Ground Conductors

Wire between Ground Grid and other points of the system shall be un-insulated copper with conductor properties, as required by the National Electrical Code and the Electricity Act of Pakistan.

19.2.2 Earth Bar

1. Each sub-station shall have a main earth bar consisting of a hard drawn high conductivity copper bar of at least 50 x 6 mm, mounted on stand-off insulators. Connections to this bar shall be by brass bolts, flat washers, nuts and lock-nuts.
2. The system neutral, where applicable, earth bars of all switchboards and all earthing terminals of all transformers shall be securely bonded to the main earth bar. For bonding purposes a copper earthing strip may be used, at least 25 x 3 mm in cross-section.
3. Metal sheaths and armouring of all incoming, outgoing and interconnecting sub-station cables shall be securely bonded to the main earth bar. The sizes of bonding conductors shall be in accordance with IEE Regulations Section 543. Bonding conductors may be connected to the earth bar of the switchboard or other apparatus served.
4. All cables and conduits used throughout the installation shall be securely bonded to the associated equipment and earthing straps shall be fitted. To facilitate such bonding, all cable glands shall be supplied with substantial armour clamps, having additional earthing lugs.
5. Compression glands shall be fitted with earth tags and brass set screws.
6. Earthing terminals of every distribution boards, isolator or switchgear item or other apparatus shall be securely conductor or 25 x 3mm copper strip or by connecting the bonding conductors to the earth bar of the apparatus.
7. All electric motors and other items of electrical equipment within the Contract shall be bonded to earth by flexible copper tables, braids or conductors of not less than 6mm2 equivalent size connected to the armouring of armoured cables.
8. All bonding of motors shall be to the stator frame of the motor. Bonding to end-shields, terminal boxes and the like is not acceptable.
9. Incoming gas, water, piped services and ducting shall be bonded in accordance with the requirements of IEE Regulation 413-2. The minimum size of the bonding conductor shall be 6mm2. Copper strip of green and yellow PVC insulated single core copper cables shall be used.
10. Earth clamps shall comply with BS 951. In dry areas tinned brass clamps shall be installed. In areas where dampness is to be expected phosphor bronze clamps shall be used.
11. Where electrical components are mounted on custom built frames, each of the above earth bonds shall include the metalwork of the support structure.
12. Conduit or trunking shall not be used as the sole circuit protective conductor.

24.2.3 Exothermic Weld

All cable to ground rod connections and all connections elsewhere shall be accomplished by the exothermic welding process.

Furnish all materials and molds necessary to properly perform all required exothermic welds.

19.3 Execution

19.3.1 General

Conduits, panels, metal boxes, cabinets, fixtures, outlets and other metal enclosures surrounding or containing electrical equipment, motors or apparatus with metal frames shall be grounded in accordance with the Electricity Act of Pakistan.

The network shall comply with the Electricity Act of Pakistan. The CONTRACTOR shall be responsible for satisfying the Government Inspector that the earthing installation complies with this Act.

19.3.2 Installation

The electrical continuity of all metal raceways shall be insured by means of properly installing locknuts, bonding straps or other approved means. Provide a separate conductor in all circuits installed in flexible conduit and bond the conductor to the cabinet, outlet box, etc., at each end of the run. Ground connections shall be made by means of welded or bolted ground clamps or grounding-type bushings.

Equipment grounding conductors shall be provided with green colored insulation in all raceway.

20.0 MOTORS AND ITS CONTROLLERS/ CONTROL PANELS

20.1 General

20.1.1 Summary

This chapter addresses the work related to furnishing and installing the electric motors that drive the pumps at the sites specified, including all supervision, labor, materials and equipment in the work for component materials and functionality of the equipment that starts and stops the motors.

20.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

20.1.3 System Description

1. The motor & motor housing should be designed for usage with wastewater/ sewage.
2. Noise level and vibrations of the motors after repair and service shall be according to relevant standards. CONTRACTOR will demonstrate that the parameters (horsepower and efficiency) of the motors after repair and servicing have been restored.
3. Motor Control Cabinets shall be custom-engineered enclosures suitable for mounting as indicated on the approved drawings and contain the system components indicated on the approved drawings and specified herein. Unless specified, all controls, meters, and devices shall be placed within the interior of the cabinet.
4. The CONTRACTOR has to perform installation, testing and commissioning of all the systems described below including pumps and motor assembly and all related equipment including Motor Control Centres (MCCs), flow meters and Automation System to the satisfaction of the ENGINEER.

20.1.3.1 Specifications of Motors

All submersible pumps supplied should be coupled with suitable motor as indicated in the BoQ. The motors should be operable at 400 Volts, 3 phase, 50 Hz AC electric supply.

20.1.3.2 Operations and Maintenance Manual:

Provide complete manual for each pump room including all submittal data, wiring diagrams, testing reports, etc. Manual shall include names, addresses, location, phone number, e-mail address, fax phone number, of supplier, installer and factory. Additionally, provide a complete schedule of maintenance. Provide six copies of each manual in a 3-ring binder with a printed cover.

20.2 Products

05.2.1 Motors & Controllers

Motors and Controllers shall conform to the latest applicable standards of the NEMA and ANSI for type and class as specifically applied.

20.2.1.1 Type of motors:

1. The motors shall be 3-phase AC induction motors operating at 400V AC and 50 Hz.
2. High-efficiency motors should be used.

20.2.1.2 Thermal Overheat Protection

1. The motors should be capable for continuous operation for at least 24 hours without exceeding the temperature rise limits for the motor insulation system.
2. The motors should shut down on the detection of excessive temperature.
3. The motors shall be provided with RTDs to monitor temperature of bearing and winding.

20.2.1.3 Motor power supply

The motors must be designed to operate with voltage levels 10 percent above or 5 percent below the nameplate rating of 400V AC.

20.2.1.4 Approved Manufacturers

Approved manufacturers for electric motors include:

- Siemens
- ABB
- KSB
- Approved equal

20.2.2 Motor Control Panels

Before placing the order, the contractor must submit shop drawings showing layout plan and electrical arrangement of the control panels for approval of the Engineer.

20.2.2.1 Components

The control panel shall include circuit breakers, dry running protection, relays, timers, control buttons and switches, meters, indicating lights and terminal boards as specified and required. The control panel shall be generally arranged as described herein. Should the physical size of any component vary from that shown on the Plans; the control panel shall be modified, as required, maintaining the same basic order of components.

20.2.2.2 Enclosure

The enclosure may be constructed as one piece or in sections, shall be NEMA 12 in design, wall mounted or of free standing style suitable for pad mounting.

The enclosure shall be provided with mechanical interlocks arranged in a manner that will completely prevent the opening of any and all enclosure doors; unless the flange mounted circuit breaker serving the respective section is in the de-energized position.

20.2.2.3 Panel Components

1. Wires shall be identified at both ends by adhesive wire labels and all wire numbers shall appear on shop drawings. No two wires shall have the same number. All motor wiring and line wiring in the control panel shall be copper type THHN or THWN. All wiring shall conform to NEMA, JIC, NMTBA Standards, or equivalent, and be completely connected, requiring only connection for service.
2. All equipment in the control panel shall be identified by nameplates. Devices such as indicating lights, selector switches, etc., should also be provided with standard nameplates.
3. Control relays shall be 10 ampere multi-pole machine tool type. Each contact shall be housed in a clear plastic enclosure to permit visual contact inspection. Contacts shall be easily convertible from normally open to normally closed and vice versa. The relays shall hold up to eight convertible contacts and four fixed contacts for a total of 12 pole capability. Relay magnets shall be of CI design and have a double-wound, molded epoxy magnet coil. Relays shall have a concealed but accessible operator for manual operation with provisions for holding the relay in the energized position for circuitry testing. Provide relays as required for system operation.
4. Pushbuttons, selector switches and pilot lights on the face of the control panel shall be 30mm diameter, NEMA 12. Lights shall have long life LED lamps.

20.2.2.4 Arrangement

All components shall be wired to terminal strips for wiring and quick-disconnect bulkhead fittings for tubing.
The control panel shall house the following:

1. A level sensing system as specified to sense liquid level and transmit it to the PLC
2. A motor-winding-overheat system for each pump motor, which shall consist of temperature sensors imbedded in the motor windings, and necessary relays, timers,

and indicators in the control panel. If sensors indicate a high winding temperature, relays in the control panel shall stop the respective motor. The sensors in the winding shall reset, automatically, when temperatures return to normal.

3. A voltage monitor shall continuously monitor supply side voltage to the control panel. The voltage monitor shall provide protection from under voltage, power loss in any phase and voltage unbalance. The monitor shall have separately adjustable pickup and dropout ranges and maximum 6 second time delay of drop out. Activation of the voltage monitor shall disconnect power to the pumps. The voltage monitor shall automatically reset upon restoration of proper voltage. The monitor shall have one set of normally open contacts with a minimum 3 ampere continuous current rating for remote alarm function.
4. A failure-to-pump alarm and shut down system for each pump, which shall consist of a lever arm type limit switch mounted on the discharge check valve at the pump, and necessary relays, timers, pilot lights and control switches in the control panel. When a pump is called upon to run, a time delay shall be energized to allow enough time for the pump to establish flow. If, after this set time elapses, the check valve limit switch has not detected flow, then the respective failure-to-pump light on the control panel shall be illuminated. A failure-to-pump condition shall not lock out the pump. The failure-to-pump light shall remain illuminated until the system is reset manually.
5. Interposing relays, as required, between PLC outputs and other system components.
6. The following components shall be mounted in the door or doors of the control panel with components directly associated with a pump in the door of the section containing control components for that pump and components common to the system and to both the pumps in the door of the system control section or sections:
    i. 1 – White “control on” pilot light
    ii. Manual transfer switch to switch between the PLC and wet well level gage.
    iii. Hand-off-auto switches, one for each pump motor. Provide extra set of contacts in switch to provide means for detection of pumps in “off” or “hand” position. Handle shall be illuminated when switch is in the auto position by long life LED lamp, or separate pilot lights may be provided to indicate this condition.
    iv. 1 – Selector switch for pump alternating (sequencing) system.
    v. Pilot lights, one for each pump, to indicate a failure-to-pump condition.
    vi. Reset pushbuttons, one for each pump, for reset of the failure-to-pump condition.
    vii. Pilot lights, one for each pump, to indicate a motor overload trip condition.

20.2.3 Motor Starters

Suitable Automatic Star Delta (ASD) Starter system shall be installed for starting of all electric motors. ASD Starter system shall be subjected to prior approval of its design from the ENGINEER.

Each starter shall be provided with an interlocking mechanism that disconnects all external sources of power from the terminal blocks within the starter.

The starter systems should at least contain the following:

1. One properly sized main circuit breaker
2. A step-down transformer for station voltage of over 400 Volts.
3. A circuit breaker and starter for the starting of each pump motor properly sized for motor running current and short circuit protection on all three phases of the motor.
4. An adjustable three phase voltage sensor to protect motors and motors starters from single phasing & under voltage.

20.3 Execution

20.3.1 Work Included

1. The motors should be provided complete with holding down bolts, base-plates, slide rails, standard shaft extensions and couplings or drive pulleys as necessary.

2. Special ventilation/cooling arrangements should also be made for the motors if required.
3. The CONTRACTOR shall furnish all supervision, labor, materials, equipment and incidentals required to provide, install, test and place into operation the controllers as required for energizing & de-energizing the pump motors. CONTRACTOR shall also provide and install all related equipment and accessories as shown and specified.

20.3.2 Mounting

Mount Motor Controllers/ Panels securely to floor or wall with stainless steel anchors specifically designed for such installation. Manufacturer shall provide the diameter of fasteners. Fasteners shall be provided complete with washers, nuts, and miscellaneous hardware.

20.3.3 Installation

Provide a complete motor control panel, including equipment and systems as specified herein, all in accordance with NEMA Standards.

Supply voltage shall be as indicated on plans.

Installation procedures shall be in accordance with the recommendations of the manufacturers of the control panel and its components.

20.3.4 Testing

The complete control panel shall be subjected to a factory test for proper operation.

20.3.5 Field Test

The equipment shall be tested in operation in the presence of the EMPLOYER and ENGINEER to demonstrate compliance with specification requirements.

20.3.6 Startup Assistance

The CONTRACTOR shall furnish the services of a fully trained competent representative to assist in startup, programming, calibration and adjustment of the equipment. Such services shall be for a period of not less than eight (8) hours, on-site.

20.3.7 Maintenance and Operating Instructions

The control panel shall be connected, inspected and tested under the supervision of a representative of the manufacturer. The representative shall also instruct EMPLOYER personnel regarding proper operation and maintenance of the equipment. In addition, the manufacturer shall furnish three (3) copies of a bound manual covering complete operating instructions and maintenance requirements for all components of the control panel. The manual shall include a numbered parts list and complete wiring, interconnection and schematic diagrams.

20.3.8 Costs

The cost for provision and installation of electric motor with each pump provided is deemed to be included in the cost of pumping set quoted in the BOQ. No additional cost for coupling of motors with pumps or procurement/ installation of allied accessories will be allowed.

20.4 Pressure Gauge

A pressure gauge shall be installed with each pump. Specifications of pressure gauge are shown below.

Table 25-1: Technical specification of Pressure gauge.

Pressure Gauge Type	Liquid filled (Glycerin)
Range	20 barg
Dial Size	6”
Process connection	½” or ¾”

20.5 Flow Control

The CONTRACTOR shall submit flow control and bypassing arrangement plans to the ENGINEER for review and approval at least 14 days prior to commencing work on each portion of the system. Flow control includes, but is not limited to, plugging, bypass pumping or hauling as appropriate for the work to be performed. The plans must be specific and complete, and shall include, but not be limited to, the following details:

1. Capacities of equipment.
2. Number and types of pump
3. Protection against pipe breaks.
4. Size, length, material, and method of installation for suction and discharge piping.
5. Method of noise control for each pump and/or generator.
6. List of emergency CONTRACTOR contact phone numbers.

21.0 LIGHTING

21.1 General

21.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work for lighting. CONTRACTOR shall provide all the lighting fixtures required.

21.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

21.1.3 Quality Assurance

1. Fixtures shall be U.L. listed or equivalent, as approved by the ENGINEER.
2. Light fixtures shall be mounted in accordance with manufacturer's recommendations.

21.1.4 Qualifications

21.1.4.1 Manufacturers:

Firms regularly engaged in manufacture of lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

21.1.4.2 Installer

Installer should be qualified with at least 3 years of successful installation experience on projects, with lighting fixture work similar to that required for the project.

21.1.5 Product Delivery, Handling & Storage

Deliver all materials in good condition. Store in dry place, off ground, and keep dry at all times.

21.2 Products

21.2.1 Location

Lights are required to be installed at the following locations:

21.2.1.1 Interior

1. The interior of pump stations, whether at grade or below grade, shall have a lighting system specifically designed to provide illumination best suited for the station layout which may include suspended, wall, or ceiling mounted.
2. Energy efficient fluorescent fixtures are preferred.
3. Lighting shall be at levels adequate for routine service inspections and maintenance activities.

21.2.1.2 Exterior

1. Exterior lights shall be provided to adequately light the equipment area.
2. The lights shall be appropriately shielded to prevent “spillage” on to neighboring properties.
3. Exterior lift station lighting shall be fitted with day/ night sensors for automatic on-off operation and shall also be fitted with manual on-off switches.

21.2.1.3 Other lights

1. Work lighting shall be installed in all cabinets and over the wet well and shall operate on manual on-off switches.
2. All other light necessary for the operation of the two pumping stations shall be installed.
3. All the buildings on the site including the pump rooms and the Generator room must also be provided with ample lighting.

21.2.2 Materials & Equipments

1. Halogen Lamps & Energy saver lights shall be used on the locations for lighting.
2. Detailed plans must be approved by the ENGINEER before final implementation.
3. Lamps of the required wattage shall be supplied and fitted before completion of contract.

21.3 Execution

21.3.1 Installation

1. CONTRACTOR shall furnish supports for light fixtures.
2. The fixture manufacturer's catalog numbers, describing the various types of fixture, shall be used as a guide only and do not include all the required accessories or hardware that may be required for a complete installation. The CONTRACTOR shall be responsible for furnishing, at no additional cost to the EMPLOYER, all the required accessories and hardware for a complete installation. He shall be responsible for ordering the proper fixtures with hardware for installation in or on the specified surfaces
3. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance of the building by the ENGINEER/EMPLOYER.
4. The CONTRACTOR shall include for the supply, delivery and erection of lighting luminaries together with all necessary accessories for the proper and secure fixing of all luminaries. Where extra supports are necessary to carry luminaries of exceptional weight these supports shall be provided and installed by the CONTRACTOR.
5. The CONTRACTOR shall check final positions of all lighting points with the ENGINEER before installation commences and obtain his approval.
6. All lighting luminaries shall be mounted and located in such positions as to be readily accessible for maintenance purposes from ladders or steps.

21.3.2 Color Code

All cables, wiring and busbars shall comply with the following color code, including single core wiring, sleeves of mineral insulated metal sheathed cable, identification tape on the cores of paper insulated and similar cables and on short lengths of single core cable used to interconnect electrical apparatus:

1. TP, TPN, DC 2 wire, DC 3 wire, in accordance with Tables 51A and 51B of the IEE regulations (17th edition).
2. SPN - Main or sub-main cables, single core interconnections on switchgear and the like, busbars and risers - Red or Yellow or Blue, Black.
3. SPN - Final sub-circuit wiring - Red, Black (irrespective of phase).

21.4 Wiring Devices

21.4.1 Products

1. All wiring devices provided on this project shall be by the same manufacturer and shall be specified grade.
2. Local switches shall be single pole and three way of required ratings.
3. Duplex convenience receptacles shall be for 220 volt, 2- pole, 3-wire, NEMA or equivalent standard, grounded type.
4. Ground fault circuit interrupting receptacles shall conform to NEC, or equivalent, and shall have a visible indication of a tripped condition.
5. Earthing will be connected with the main power panel.

21.4.2 Installation

Devices shall be installed in a rigid manner in outlet boxes. Device plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16-inch.

22.0 BACK-UP POWER SYSTEM (DIESEL FUELED)

22.1 General

22.1.1 Summary

This chapter addresses the work related to furnishing and installing all supervision, labor, materials and equipment in the work for component materials and functionality of the equipment that provides back-up electrical power to operate the pumping station when service from the power grid fails.

22.1.2 Submittals

Submit all relevant shop drawings and manufacturers data for this chapter.

In addition to full descriptive data, dimensional drawings, and wiring diagrams, the following information must be furnished for evaluation of all equipment proposed:

1. Name and location of engine-generator supplier's parts and service facilities.
2. Manufacturer's Published Warranty.
3. Manufacturer and Model of Engine.
    i. Bore, stroke, and number of pistons.
    ii. Engine displacement.
    iii. Piston speed.
    iv. Engine rating at 1800 RPM.
    v. BMEP.
    vi. Exhaust emissions data.
4. Manufacturer of generator, make and type of generator, and generator electrical rating.
5. Manufacturer and type of voltage regulator.
6. Manufacturer and model of batteries and battery charger.
7. Manufacturer and type of governor.
8. Manufacturer and model of weather protective enclosure.

22.1.2.1 Operations and Maintenance Manual:

Provide complete manual including all submittal data; testing reports, etc. Manual shall include names, addresses, location, phone number, e-mail address, fax phone number, of supplier, installer and factory. Additionally, provide a complete schedule of maintenance. Provide six copies of each manual in a 3-ring binder with a printed cover.
The manual shall also include a list of O&M procedures and their detailed description for the generator for up to 5 years of operation; in addition to Maintenance and Management System (MMS) routines for weekly, monthly and quarterly frequencies.

22.1.3 Electrical General Provisions

It is the intent of these specifications to secure an engine driven, diesel fuel fueled, generator set of the latest commercial type and design as specified herein, complete with digital electronic controls. All material and equipment shall be new and undamaged. All equipment supplied shall meet the requirements of NFPA-110 standards. Generator set shall be UL 2200 listed or equivalent.

22.1.4 Work Included

Provide a standby power rated emergency generator set with accessories and attachments in strict accordance with these specifications. Services shall include installation supervision, initial start-up and checkout, and acceptance testing as detailed herein.

22.1.5 System Description

Provide a new, packaged generator set within a weatherproof sound attenuating enclosure for supply of electrical power in event of failure of normal electrical power supply, consisting of liquid-cooled, diesel fuel fueled engine directly coupled to AC generator, complete with frame mounted fuel tank, control panel, auxiliaries, meters, and safety devices necessary for a complete operating system.

The unit shall be capable of delivering the KW required at installed location after consideration of applicable de-rating factors.

22.1.6 Experience

The engine-generator set shall be the product of a firm regularly engaged in the manufacture of engines and generator sets and shall meet the requirements set forth herein. The equipment must be a standard model in regular production at the manufacturer's place of business. The generator set supplier shall also be the manufacturer of either the engine, the generator, or both major components. All components shall be covered under the warrantee of the supplier.

The engine-generator supplier shall be factory-authorized sales and service dealership for the equipment to be supplied. The supplier shall maintain a parts and service facility within 50 miles of the project site, with an inventory of maintenance and repair parts for the equipment to be provided, as well as a staff of trained service technicians. The supplier shall furnish all installation and testing supervision necessary for final approval and acceptance of the equipment by the ENGINEER.

22.1.7 Codes and Standards

The latest effective publications (listed below or equivalent) of following standards, codes, etc., as they apply, form part of these specifications as if written fully herein and constitute minimum requirements. Minimum requirements shall not relieve the CONTRACTOR of the responsibility for furnishing and installing higher-grade materials and workmanship than therein specified. These will be referred to throughout the abbreviated forms.

9. EPA SI NSPS – Environmental Protection Agency Spark-Ignition New Source Performance Standards.

22.2 Products

22.2.1 Emergency Generator Unit

All materials, equipment and parts comprising the units specified herein shall be new and unused, of current manufacturer and of highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade in accordance with modern practice.

22.2.1.1 Design and Construction

The design and construction of the emergency generator unit shall be neat and clean in appearance. Normal adjustments and maintenance must be accessible without the use of special tools. The engine, generator and all major items of auxiliary equipment shall be products of manufacturers regularly engaged in the production of such equipment, and shall be assembled, tested and shipped to the job site by the engine/generator manufacturer or his authorized distributor.

22.2.1.2 Power Rating

The unit shall have a minimum power rating as indicated in the BOQ at a 0.8 power factor and a frequency of 50 Hz. It shall operate at rated RPM. Rating shall be substantiated by the manufacturer's standard published curves and related data. Special ratings for a particular application will not be accepted. Rating shall reflect the net power available after deducting all engine-driven accessories. Maximum voltage dip shall be up to 30%.

22.2.1.3 Output voltage

The generator output voltage shall be as indicated in the BOQ. The regulator shall be of the three-phase sensing type. Voltage regulation shall be plus or minus 1.0 percent from no load to full load. An adjusting rheostat shall provide a plus or minus 5 percent voltage adjustment. Steady state frequency regulation shall be plus or minus 0.25 percent. The generator unit control system shall provide for instantaneous field over current trip to protect the voltage regulator in the event of output short circuit or improper connections.

22.2.1.4 Generator Size

The generator shall be sized to provide the specified output under job site conditions and shall be built to NEMA, IEEE and ANSI standards. It shall be a three- phase, 4-wire, 50 Hz, 0.8 power factor, single bearing, rotating field synchronous type. Readily accessible voltage level and voltage drop controls shall be provided.

22.2.1.5 Generator Engine

The engine shall be a full compression ignition diesel, four stroke cycle, single acting, solid injection, water cooled, in-line or “V” type. The engine shall be turbo-charged and after-cooled in accordance with the manufacturer's standards as required to perform the specified duty. The engine shall be equipped with an electronic governor for 1% regulation. The engine shall be capable of full load duty when operating on a commercial grade of fuel. Engines requiring a premium grade of fuel will not be acceptable. The engine shall be equipped with reliable fuel, lube oil, and air intake filters, lube oil cooler, fuel transfer pump, fuel priming pump, and any other attachments required for continued, dependable, and low maintenance cost operation. Filter arrangements designed for light duty standby service will not be accepted.

Furnish an engine mounted radiator of sufficient capacity to maintain a safe engine operating temperature at the specified standby power load when the ambient temperature is 105 degrees F as specified and installed in the generator radiator as specified herein and on the drawings. The radiator shall be equipped with a blower-type fan with fan guard. The fan belts shall have a tension adjustment. The engine shall be equipped with an engine mounted jacket water pump and thermostat to properly control engine temperature. A suitable rust inhibitor shall be included in the coolant solution.

22.2.1.6 Changeover Switch

A manual changeover switch, to operate the pumping station using the backup generator when the electric supply by the Power Company is absent, is also to be provided.

22.2.1.7 Base

The emergency generator unit shall be mounted on a structural steel base, suitable for mounting to a sub-base fuel tank. The unit shall be equipped with linear type vibration isolators or a quantity and type recommended by the manufacturer.

22.2.1.8 Exhaust silencer

Provide a critical grade exhaust silencer, properly sized by the manufacturer for the specific engine installed. A stainless steel flexible exhaust fitting shall be provided between the engine and exhaust silencer. The exhaust system shall be sized to ensure against loss of power due to excessive back pressure. The exhaust silencer shall be installed within the enclosure. Silencer shall be constructed of stainless steel. Silencer discharge shall be directed vertically upward. Silencer shall be provided with a rain cap. Rain cap shall be provided with a rubber grommet to prevent the rain cap from directly contacting the silencer.

22.2.1.9 Batteries and charger

Furnish and install a 12 or 24 volt DC electric starting system. The starting system shall include two lead-acid batteries complete with cables. The ampere-hour capacity of the system shall be a minimum of 135 ampere-hour. Batteries shall be mounted inside the enclosure, adjacent to the engine.

Furnish and install a two-rate 12 or 24 volt DC battery charger suitable for use with lead-acid batteries. The charger shall be furnished with an automatic equalizing charge timer for fast recharge, and a low DC voltage alarm contact. It shall be suitable for operation on single phase, 220 volts, 50 Hz, AC. Battery charger output shall be 10 amperes. Mount charger on the generator set with a corrosion resistant enclosure.

22.2.1.10 Control Panel

A digital engine starting and control system shall be furnished by the engine manufacturer and included in a NEMA-1 generator control panel that shall be factory installed, with vibration isolators, on the generator set. The control panel shall meet UL508A. The starting controls shall be manually actuated. The engine starting controls shall be solid state and shall include, as a minimum, the following functions and equipment:

1. Instruments, including ammeter, voltmeter, frequency meter, tachometer, and hour meter.
2. Start-stop control module with adjustable cycle cranking and engine cool-down timer.
3. Ammeter - Voltmeter phase selector switch.
4. Engine control switches for auto, start/run, off/reset, and stop.
5. Oil pressure and water temperature gauges.
6. Safety shutoffs with individual alarm lights for low oil pressure, high water temperature, over-speed, and over-crank.
7. Emergency stop push-button.
8. Voltage adjust rheostat.
9. System diagnostic codes, digital readout.
10. DC panel illumination lights with switch.
11. Signal to alarm transmitter for generator failure (Common fail - all generator failure leads shall be connected together.)
12. Signal to alarm transmitter for fault (Common fault - all fault leads shall be connected together.) Dry contacts shall be rated to handle the voltage and current derived from the alarm transmitter.
13. Signal to alarm transmitter for generator running status. Dry contacts shall be rated to handle the voltage and current derived from the alarm transmitter.
14. Signal to alarm transmitter for fuel level.

In addition to the functions and equipment listed above, the generator control panel shall incorporate an automatic pre-alarm module in accordance with NFPA-110 with individual alarm lights and common alarm horn for:

1. Approach low oil pressure.
2. Approach high water temperature.
3. Low water temperature.
4. Low battery voltage (from battery charger contact).
5. System not-in-automatic.
6. Low fuel level.

All generator functions shall be fully programmable from the generator control panel. Generators requiring external devices or software for programming functions will not be accepted.

22.2.1.11 Moulded Case Circuit Breaker

A moulded case circuit breaker, rated as indicated on the drawings, shall be provided and mounted at the generator to provide overload protection and disconnect means. The breaker shall be installed in a NEMA-1 enclosure within the generator set enclosure and shall be equipped with copper output bus bars to accommodate the quantity and size of conductors per phase as shown on the drawings, plus the neutral and ground conductors as indicated. Neutral leads shall be brought out and terminated to an isolated bus bar mounted within the circuit breaker enclosure.

22.2.1.12 Enclosure

The generator set shall be enclosed in a factory installed UL2200 listed 14 gauge steel weather protective enclosure with polyester powder finish. Finish shall be factory painted. The enclosure shall have an internally mounted silencer and a minimum of four lockable, gasketed personnel doors for maintenance access, along with fixed air intake and radiator discharge louvers. The enclosure shall have the best (quietest) sound attenuating package offered by the manufacturer to achieve a maximum sound level under full load of 78 dBA at 25 feet from unit.

22.2.1.13 Fuel Tank

The generator set shall be installed on top of a UL 142 listed double wall base mounted fuel tank. The tank shall be constructed of primed/painted structural steel and be provided with all required accessories such as: venting, manual fill provisions, fuel level gauge, low level and tank rupture alarm contacts. Tank color shall match the generator enclosure. Tank shall be sized to provide a minimum of 24 hours of continuous operation at full rated load. A primary fuel filter/strainer shall be provided and mounted between the tank supply fitting and the engine fuel inlet. Flexible fuel lines shall be provided between all components. The tank base shall be equipped with four-point lifting provisions designed to allow safe unloading and setting of the complete generator set and tank/enclosure assembly.

Provide a fuel tank monitoring system to monitor actual fuel level within the tank. The system shall provide a 4-20 mA output.

22.2.1.14 Spare parts

One year's supply of spare parts/ maintenance kit will be provided by the contractor for operation and maintenance of each generator set. The contractor will also submit list of recommended spares and list of consumables for next 5 years along with price list.

22.3 Execution

22.3.1 Coordination

Coordinate with all trades and vendors to provide an efficient and well coordinated system.

22.3.2 Installation

Install generator set as indicated on the drawings and in accordance with the manufacturer's instructions and recommendations. Installation shall be in accordance with all applicable local, state, and federal codes and regulations.

Generator set shall be mounted on a concrete pad that is independent of all other concrete slabs or structures.

22.3.3 Wiring and Connections

Provide conduit, wiring, and connections within the enclosure packages. Provide field wiring consisting of power and control wiring between the emergency generator unit and the manual transfer switch.

Provide field wiring from the emergency generator unit to the alarm transmitter for the following alarm points.

1. Generator Running
2. Common Generator Failure
3. Common Generator Fault
4. Fuel Level

22.3.4 Testing

The emergency generator unit shall receive the manufacturer's standard testing at the factory. The factory testing shall be at 0.8 power factor. Certified copies of the factory test shall be supplied to the ENGINEER. Prior to acceptance of the installation, the equipment

shall be field tested to show it will start manually, complete a full load test, shut down and reset as required by these specifications.

Prior to acceptance, any defect which becomes evident shall be corrected. The test shall be performed in accordance with the following minimum requirements and shall include any other tests that may be recommended by the manufacturer or ENGINEER for the purpose of evaluation. A portable resistive (1.0pf) load bank shall be utilized for the field test. The generator shall be started and operated at 50% of rated load for a period not less than ½ hour, after which the load shall be increased to 75% of rated load and operated for the second ½ hour. The load will be then increased to 100% and held continuously for a period of not less than two hours, then operated at no load for a period of 15 minutes prior to shutting down the generator set. A full written report indicating KW output, voltage, current, frequency, oil pressure, water temperature, and ambient temperature variations taken at 15 minute intervals during the test shall be provided to the ENGINEER for evaluation and disposition. All tests shall be performed in the presence of the ENGINEER'S authorized representatives and the manufacturer's representative who shall validate the report. Fuel for testing shall be furnished by the CONTRACTOR.

Upon completion of the field testing, operating instructions and maintenance procedures shall be thoroughly explained to the operating personnel. Four sets of operating and maintenance manuals shall be supplied for the emergency generator unit and related auxiliary equipment.

Upon final acceptance, CONTRACTOR shall fill the generator's fuel tank to capacity for final delivery to ENGINEER.

22.3.5 Screening

Provide visual screening for the generator set as indicated on the drawings. Screening shall consist of a shadow box style fence with minimum 6" wide slats, minimum 50% overlap and maximum 50% gap. Minimum fence height shall match the height of the emergency generator unit enclosure.

22.3.6 Power Factor Improvement (PFI) plant

The CONTRACTOR shall provide/ install PFI capable to maintain power factor at 0.95 to 1, in case of less power factor from power utility company. It should be approved by the ENGINEER before installation.

23.0 GENERAL MECHANICAL SPECIFICATION

23.1 General

23.1.1 Summary

The following Clauses shall apply to all relevant materials and procedures throughout the Mechanical Specification, unless other instructions are given in specific clauses of other Chapters of this Specification.

The following clauses of this Chapter of the Specification set out the minimum standards for Plant and workmanship to be used by the CONTRACTOR for the mechanical services Works. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this section.

Reference to any specific equipment or material does not necessarily imply that such material or equipment is to be included in the Works.

23.1.2 Submittals

Submit all relevant shop drawings and manufacturers data.

Shop Drawings including detailed layout drawings shall be submitted to the ENGINEER for approval; and shall include dimensioning, methods, and locations of supports, and all other pertinent technical specifications for all works to be furnished.

23.2 Products

23.2.1 Pipe Work and Ancillaries

23.2.1.1 General

All materials used shall be suitable for the use for which they are intended, including being tested.

Materials shall comply with all relevant Standards and Codes of Practice.

23.2.1.2 Non-return Valves

Non-return (or check) valves shall be bronze swing pattern with screwed bonnet, metal to metal seat, pressure rating PN 25 and comply with BS 5154 Series ‘B’.

23.2.1.3 Strainers

Strainers up to 50 mm nominal bore shall be bronze ‘Y’ pattern of pressure rating 32 bar at −10 to 120^{o}C with perforated copper sheet screens having 0.84 mm diameter x 54 holes per cm^{2}.
Strainers of 50 mm nominal bore and above shall be cast iron ‘Y’ pattern of pressure rating 17 bar at 100^{o}C with bolted cap and perforated stainless steel screen having 0.75 mm diameter x 61 holes per cm^{2}.

23.2.1.4 Pressure Gauges

Pressure gauges shall be mounted such that they can be read easily from ground or access platform level. Gauges shall be fitted using a female screwed outlet on the pipe.

23.2.1.5 Pipeline Installation

All exposed pipe runs shall be arranged to present a neat appearance, generally following the building structure.

Vertical pipes shall be plumb and all pipes shall be installed to facilitate natural draining and venting.

23.2.1.6 Other works

23.2.1.6.1 Joint Location

Joints shall not be made within the thickness of walls, floors or ceilings.

23.2.1.6.2 Tools

The correct tools shall be used for the assembly of pipe work, and any protective coatings marked shall be made good.

23.2.1.6.3 Cleanliness

Pipe work and fittings shall be inspected and foreign matter removed before installation.

As the installation of pipe work proceeds, all open ends shall be sealed with plugs, caps or blank flanges to avoid ingress of foreign matter. Under no circumstances shall paper or wood be used for this purpose.

At the completion of all or sections of the Works the pipe work or sections of pipe work shall be flushed out until all loose material has been completely removed. This flushing shall be in addition to any subsequent cleansing requirement.

23.2.1.6.4 Pipe Cutting

Pipes shall be cut clean and square with the axis, and all burrs removed.

23.2.1.6.5 Anti-vibration Couplings

Suitable anti-vibration couplings shall be provided to all moving machinery, and shall be installed such that they do not transmit any transverse stresses to or from the plant.

The couplings shall be installed without twisting, misalignment, stretching or compression.

Stool pieces shall be fitted during any testing that produces conditions outside those recommended for the couplings.

23.2.1.6.6 Vibration Isolation

All dynamic machinery shall be isolated from the building structure by vibration isolators or material designed and selected to suit the machinery.

Isolation components shall be installed in accordance with the manufacturer's instructions.

23.2.2 Pumps & Pumping Plant

23.2.2.1 Electric Motors

1. All motors shall comply with the appropriate standards mentioned in Chapter 20 and shall be of such a size and type to adequately drive the Plant under all normal conditions of service without overloading. Motors of 1 kW and greater shall be 3 phase.
2. All fan, pump, stoker and burner motors shall be continuously rated. The insulation shall comply with Class F.
3. Motor enclosures shall comply with BS 5490. Fan, pump, and similar motors larger than 1 kW shall be screen protected and drip-proof except in solid fuel fired boiler houses. Motors of less than 1 kW and all motors in solid fuel fired boiler houses shall be totally enclosed. Motors positioned remotely from their starters shall be provided with load-breaking isolating switches fitted adjacent to them.
4. Motors arranged for automatic restart shall have a label of durable material fixed permanently to them in a prominent position and having, in clearly inscribed characters, the legend:
   DANGER: THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING. ISOLATE BEFORE INSPECTION.
5. Direction of rotation shall be clearly indicated.

23.2.3 Controls & Instrumentation

23.2.3.1 Extent of Work

The extent of controls and instrumentation shall include all electrical, electronic or pneumatic actuators and sensing devices, motor starting equipment, control panels and control wiring and tubing serving items of Plant.

The installation of the controls shall be carried out by a control specialist, who shall also commission the system, provide record drawings and manuals, and guarantee the system.

23.2.3.2 General Requirements

The following requirements shall be met:

1. Basic adjustments for original setting, such as slope of characteristic, sensitivity, etc shall be concealed within a lockable panel. Remaining controls shall be accessible but tamper-proof.
2. All time switches shall have easy to operate over-ride facility, and shall have self winding spring reserve of not less than 30 hours.
3. All instructions and other writing shall be in English.
4. All control valves, dampers and the like shall have position indicators clearly marked ‘open’ and ‘shut’.
5. All hot water systems shall include high temperature protection to prevent water temperatures rising above pre-set limits.
6. All tempered air supply systems shall have low limit protection to prevent freezing of heater batteries or discharge of cold air.
7. All control valves and dampers shall be fail-safe.
8. The frequency of starts for all items of Plant shall be automatically limited to that recommended by the Plant supplier.
9. The sequence of start-up of items of plant shall be automatically controlled to avoid excessive electrical load at any time.

23.2.3.3 Control Panels

1. As far as is practicable all controls, indicator lamps and instruments elsewhere described shall be grouped and mounted together in a floor or wall-mounted panel. Oil burner and boiler automatic control units may be mounted upon or near the Plant to be controlled where this is the manufacturer’s standard practice. The panel and all items on the outside face shall be identified by means of attached white laminated plastic labels engraved with black cyphers.
2. A drawing of the layout of the control panel shall be submitted for approval before manufacture. A neat and orderly arrangement is required. Plant shall not be fixed to panels removable for maintenance and not, as far as is practicable, to opening doors.
3. The control panel shall, as far as practicable, be manufactured, equipped, wired and tested before delivery to Site.
4. The manufacturer of the control panel shall commission the completed controls installation on Site.
5. Panels shall be totally enclosed and internally wired with no live terminals or components exposed. Complete access to the interior of panels shall be provided by means of lockable hinged doors or covers at the front and/or back as necessary. A front or side-mounted integral and interlocking isolating switch shall be provided, with ON/OFF indication, amperage rating shown, and an internal earth connection. Panels of above 60 A capacity shall contain a fully insulated DP busbar with copper cable or solid copper and clamp connections. Where a panel contains both pneumatic and electric Plant they shall be contained in separate sections with doors to each section.
6. Control panels shall be constructed in accordance with the following:
    - **i. Construction**

      Panels shall be constructed of folded mild steel sheet of minimum thickness 2.5 mm, or of mild steel angle frame which supports sheets of mild steel of minimum thickness 1.25 mm, or of an approved proprietary system of construction. No sharp edges or corners will be allowed, and all exposed screws, bolts or other fixings shall have rounded heads with protective and

decorative plating. Panels shall be adequately stiffened and reinforced as necessary to ensure rigidity. A metal plinth shall be provided with provision for bolting down the cubicle. Lifting eyes shall be provided for convenience of handling.

Doors shall have gaskets for dust protection and be fitted with matt chrome plated lockable handle and catch. Hinges and front of panel screws shall be rustproofed and plated.

Ventilation openings shall be covered with galvanised mesh and vermin proof. Panels shall be finished externally with a semi-gloss stoved or cellulose enamel finish of an approved BS color. All surfaces shall be properly prepared before final finishing and the external appearance shall be of a high standard.

ii. Internal Wiring, and the like

All indicating lamps, instruments and controls shall be, as far as is practicable, of the same manufacturer and style to provide uniformity of appearance and to facilitate maintenance. Externally visible equipment shall be flush mounted, with minimum projection and fixed securely to the front panels or other members. Internal equipment shall be secured to purpose-made rails or mounting bars. All fixings shall incorporate shake-proof washers or other vibration resistant fastenings.

Circuit protection shall be by means of SP circuit breakers where circuit protection does not exceed 60 A. Where a circuit exceeds 60 A protection shall be with HRC fuses.

Indicator lamps shall be 8 V, 2.4 W MES clear and shall be supplied from a 6 V output transformer complying with BS 3535. Glasses of not less than 25 mm diameter shall be fitted. Where indicator lamps are not immediately adjacent to their associated switches they shall be clearly labeled.

Internal wiring shall be coded and in general shall be neatly bunched and run on trays or in purpose-made slotted non-combustible cable trunking. Positive fixing of cable ends shall be ensured by purpose-made clamps, or pinch-type terminals, or by the use of crimped cable tags or other approved termination devices. All cable ends shall be permanently identified.

Wiring shall be not less than 240 V insulated and shall be rated in accordance with the IEE Regulations but with a minimum of 10 A.

Grouped terminal blocks of adequate capacity with pressure bar contacts and permanent labels shall be provided for all wires leading to equipment outside the panel. Removable covers or other facility shall be provided for the entry of incoming cables, conduits, trunking, and the like, with means for effective earthing to the panel chassis.

If main power terminals are incorporated within the control panel, soldered socket type terminals shall be provided.

Fuses shall be grouped and mounted so as to be readily accessible without danger. Fuses, terminal blocks and all items of equipment shall be readily identified by means of clearly visible labels secured to them by screws or by other approved methods.

iii. Cable Entry

Removable plates shall be provided at the top or elsewhere as specified for entry of cables or pneumatic tubes. Non-ferrous plates shall be used for copper tubing or MICC cables.

All cable entries shall be sealed to prevent ingress of dirt or moisture.

23.2.3.4 Instrumentation

All instruments, gauges and devices that have indicating scales shall be mounted such that they are accessible and can be easily read without the need for portable or temporary means of access.

Scale ranges shall be appropriate within the extremes that will be indicated when the plant is running and at rest. The design maximum operating condition shall be indicated at not less

than 75% of the total scale length. Pressure gauges and dial thermometers shall be accurate to 1% of total scale reading.

23.2.3.5 Pressure Gauges

Pressure gauges shall have dials not less than 100 mm diameter and the cases shall be of polished brass or chromium plated mild steel or of approved enameled metal or of plastic. Pressure gauges shall be fitted with lever handle cocks and, where appropriate, siphon pipes.

The gauges shall be graduated in kPa and the scale ranges shall not exceed 1.5 times the maximum design working pressure.

Where gauges are provided in association with pumps, an adjustable red pointer shall mark the static head with the system normally full and the pumps at rest.

23.2.4 Testing and Commissioning

23.2.4.1 General

1. All systems shall be fully commissioned and tested in accordance with the requirements of this specification.
2. Works test certificates, where required, shall be provided in duplicate for approval.
3. A full record of all site tests shall be provided, in duplicate, for approval and further copies subsequently included in the O & M Manuals. The installation shall be demonstrated to confirm the installation is properly commissioned, operates in the correct manner and is capable of functioning satisfactorily to accomplish the design intention.
4. All certified instruments, equipment, labor and materials, electric power, fuel and water for all testing and commissioning shall be provided.
5. Notice, in writing, shall be given 48 hours prior to any portion of the Works being pressure tested.
6. In the event of any item of Plant or any section, or sections, of the Works not satisfying the prescribed tests, all faults shall be remedied and re-testing carried out until such items or sections are satisfactory and approved at no additional cost.
7. Details of all hydraulic tests and all tests on Plant or automatic controls made on site shall be recorded. No paint, insulation or non-conducting composition shall be applied to pipe work or items of Plant until all testing and witnessing of tests has taken place.
8. All test details shall include the following particulars:
    i. Apparatus or pipe work section under test.
    ii. Makers Nr (where appropriate).
    iii. Nature, duration and condition of tests.
    iv. Result of tests.
    v. Date.
9. Where climatic conditions preclude the proper final adjustment of systems at the time, such adjustments shall be carried out during appropriate conditions within the Period of Maintenance. All testing and commissioning shall be carried out in accordance with the with British Chartered Institute of Building Services Engineers (CIBSE) Codes.

23.2.4.2 Cleanliness

1. All necessary precautions shall be taken to protect the system during the period of the Contract.
2. The entire system shall be flushed through (or gas services blown through) on completion of appropriate sections.
3. After flushing, heating and cooling water systems shall be chemically cleaned to prevent corrosion and scale formation.
4. After flushing hot, drinking and cold water services they shall be sterilized to the Local Water Authority requirements.

5. After sterilizing, samples from draw-off selected points shall be taken and tested for bacterial contamination by an independent laboratory. Test certificates shall then be provided.

23.2.4.3 Pipe Work Tests

1. Upon completion of each length of pipe work the section of pipe work shall be subjected to a pressure test and demonstrated and witnessed to ensure the section is sound and tight.
2. The whole of the testing gear required including all plugs, caps, tees and drain fittings shall be provided.
3. The tests shall be applied by filling the sections to be tested with air or water as appropriate and raising their pressure to a figure equal to twice the working head or 3.5 bars (gauge), whichever is the greater, after making safe all items of equipment that may be damaged by such tests.
4. The section shall then be left without further pressurization and all joints must remain tight for a period of at least two hours.
5. All necessary precautions against freezing shall be taken and the pipe work sections emptied down after testing except those for which a Certificate of partial Completion in respect of the Works has been issued and for which responsibility has been accepted by the EMPLOYER.
6. Any pipe work or plant damaged by frost or damage caused to the building structure by flooding during the contract period shall be reinstated as new.
7. All drainage pipe work shall be blanked off at the point at which it discharges into the main drains and shall be filled with water and hydraulically raised to not less than 345 mbar and checked for leaks over a two hour period.
8. Soil pipes and vents shall be plugged and tested to an air pressure of 5 mbar. This pressure shall be maintained and witnessed for a 15 minute period.
9. All gas service pipelines shall be tested to an air pressure of 30 mbar or in the case of high pressure gases to twice the working pressure maintained for a period of 24 hours.

23.2.4.4 Vibration Testing

All plant and equipment provided shall be free from excessive vibration. Any minor vibration that may occur shall not be transmitted from the plant or equipment into or through the supporting or enclosing structure.

23.2.4.5 Performance Tests

1. It shall be demonstrated that the Works is adjusted and regulated correctly to fulfill the functions for which it has been designed, e.g., room temperatures to be maintained, air change, water temperature and outflow of water from taps, and the like. Adjustments shall be made to balance and regulate the systems as necessary until the required conditions are attained.
2. Room temperatures shall be measured by mercury-in-glass thermometers located 1.5 m above floor level at points away from the influence of draughts, adjacent heaters or direct radiation from hot or cold surfaces.
3. No demonstration of room temperatures shall be carried out when the weather conditions are abnormal as to wind or rain or at times when the external air temperature is changing at a rate exceeding 2°C per hour.
4. The CONTRACTOR shall provide all instruments, equipment and labor required for the conduct of these demonstrations together with up-to-date calibration certificates for the instruments used in the tests.
5. Not less than 7 days notice shall be given prior to the performance tests being carried out.

23.2.4.6 Automatic Controls and Instrument Testing

All automatic controls and instruments shall be tested and commissioned by the manufacturer's representative in order to demonstrate that they are capable of meeting the demands specified and they shall be adjusted to suit the characteristics of the building and the system.

All valves, switches, controls and the like shall be regulated and capable of proper adjustment to conform to the design conditions.

A signed certificate from the control or instrument manufacturer's representative confirming that the systems for control of the Plant are operating to their satisfaction shall be provided.

23.2.4.7 Plant Operation

The plant shall be operated for a period of one week using any skilled personnel necessary to ensure its safe and satisfactory operation for this period.

During this period of plant operation, instruction shall be provided to all members of the EMPLOYER's staff, who will be responsible for the future day to day operation of the plant, equipment and automatic controls.

23.2.4.8 Post-Commissioning Checks

Upon completion of the testing and commissioning, the system shall be checked to ensure that all valves, dampers and automatic controls and the like are correctly set for normal operation.

24.0 Pumps

24.1 Pump Design

The pump shall be a single stage design suitable for horizontal mode of operation. Pump shall be horizontal, radially split volute casing pump in back pull-out design, with impeller adapted to meet application requirements, single-flow, single-stage.

The main dimensions shall as far as possible be standardized.

Pumps rated less than 100 kW shall in general be delivered with guarantees according to ISO 9906 class 2B.

24.2 Pump Performance

The pump head versus flow characteristics shall be stable, rise continually to closed valve head and be non-over loading.

The pump manufacturer shall select the most economic pumps given the constraints of the operating parameters, as operating costs will be considered in association with the capital costs in the evaluation.

The pump manufacturer shall provide O&M manual for offered pump.

The margin on NPSH available to NPSH required shall be at least 1.5m at duty.

The pump driver shall be rated for a minimum margin on absorbed power of 10%, based on duty flow and shall be full on curve safe.

24.3 Pump Casing

The pump casings shall be radially split volute casing pump in back pull-out design of not less than grade cast iron EN JL1040. Flanges shall comply with BS 10 table D or similar standards.

Pump casings and discharge pipework up to and including the isolation valves and non-return valves, shall be rated for the maximum closed valve head developed; including the maximum suction pressure.

24.4 Casing Wear Rings

Casing wear rings shall be locked to prevent rotation by dowel or similar approved method.

Ease of replacement shall be a major design criterion. Casing wear rings shall be incorporated on all rotating / stationary interfaces.

24.5 Impellers

Impellers shall be of grade cast iron EN JL1040.

The impeller shall be keyed and positively secured to the pump shaft and shall be designed so that there is no tendency for any parts to unlock due to reverse rotation of the pump.

The impeller shall be dynamically balanced and then assembled to the shaft.

24.6 Pump Shaft

24.6.1 Pump Shaft design

The shaft material shall be C45N carbon steel.

The diameter of the sleeve shall not be taken into account when calculating shaft stiffness.

24.7 Bearings

24.7.1 Thrust Bearing

The axial thrust generated shall be taken by an appropriate thrust bearing design composed of either Spheroidal roller contact or deep groove ball bearings.

Thrust bearing arrangements incorporated into the motor housing are not permitted.

Setting of thrust bearings shall account for dynamic loading albeit setting is carried out with the machinery stationary.

Bearings shall be grease lubricated.

24.8 Sealing

24.8.1 General

The means of sealing shall be dependent upon the application and may be either soft packed gland or mechanical seal.

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24.21 Inspection and Testing

24.21.1 General

If specified the equipment shall be subjected to a works test to ensure that it functions correctly, performs and is supplied to specification.

24.21.2 Inspection and Testing on the Manufacturers Premises

If required the pumps shall be tested in accordance with ISO 9906 class 2B procedures described hereafter at the manufacturers premises to show the plant is capable of achieving the duty point values as detailed in the Contract.

Pump characteristic curves based on test results shall be produced for the following:

- Head/Quantity
- Power Absorbed/Quantity
- Overall Efficiency/Quantity

If any defect is detected during the tests before completion or during the warranty period the faulty equipment shall be rectified immediately by the manufacturer at his expense. If the fault cannot be rectified the manufacturer must replace the defective equipment which must also be proven to be free from defect.

25.0 POWER CONNECTION FROM SEPCO

25.1 Obtaining Power Connection from SEPCO

For satisfactory operation of the proposed electrical equipment additional load has to be obtained from SEPCO as given in the BoQ.

25.2 Execution

The Contractor will be responsible for:

1. Submission of applications, affidavits and agreements duly signed by bill payee authority in Jacobabad to SEPCO Office in Jacobabad.
2. Carrying out joint survey with SEPCO contractor, TMA official and representative of Engineer for verification of applied load.
3. Installation of step-down transformer 11 KV/ 400 V and connections with appropriate size cable HT/LT, with end termination, safety arrangements and earthing / grounding facilities as per relevant SEPCO requirement (if required).
4. Connection / end termination of these transformers to pumping station with appropriate size of cable, through incoming / outgoing panels with over / under voltage relays, PTs, CTs and all other safety arrangements / earthing System under relevant IEEE / NEC standard.
5. Connections of this newly obtained load to incoming panels of Pumping Station through main switches and with safety arrangements, grounding / earthing to stand-by Generator changeover switches.

All these connections/ equipments should be compatible with relevant applicable SEPCO standards and requirement.

TENDER DRAWINGS