

TABLE OF CONTENTS

Description

INVITATION FOR

BIDS

Form

INSTRUCTIONS TO BIDDERS

A. General

- IB.1 Scope of Bid
- IB.2 Source of Funds
- IB.3 Eligible Bidders
- IB.4 Eligible Materials, Equipment and Services
- IB.5 One Bid per Bidder
- IB.6 Site Visit

B. Bidding Documents

- IB.7 Contents of Bidding Documents
- IB.8 Clarification of Bidding Documents & Pre-Bid Meeting
- IB.9 Amendment of Bidding Documents

C. Preparation of Bids

- IB.10. Cost of Bidding
- IB.11 Language of Bid
- IB.12 Document Comprising the Bid
- IB.13 Bid Prices
- IB.14 Currencies of Bid and Payment
- IB.15 Bid Validity
- IB.16 Bid Security
- IB.17 Alternate Proposals by Bidder
- IB.18 Format and Signing of Bid

D. Submission of Bids

- IB.19 Sealing and Marking of Bids
- IB.20 Deadline for Submission of
- Bids IB.21 Late Bids (i)

Description

IB.22 Modification, Substitution and Withdrawal of Bids

E. Bid Opening and Evaluation

IB.23 Bid Opening

IB.24 Process to be Confidential

IB.25 Clarification of Bids

IB.26 Examination of Bids and Determination of Responsiveness

IB.27 Non material, Nonconformities

IB.28 Correction of Arithmetic Errors

IB.29 Evaluation and Comparison of Bids

IB.30 Abnormally Low Bids

IB.31 Unbalanced or Front Loaded Bids

F. Award of Contract

IB.32 Award Criteria

IB.33 Employer's Right to Annul the Bidding Process

IB.34 Notification of Award

IB.35 Performance Security

IB.36 Signing of Contract Agreement

IB.37 Integrity Pact

IB.38 Instructions not Part of Contract

IB.39 Corrupt and Fraudulent Practices

BIDDING DATA

Evaluation Criteria and Qualification Updating Forms

LETTERS OF BID AND SCHEDULES TO BID

Letter of Bid

Schedule-A to Bid

Schedule of Adjustment Data

Schedule -B to Bid

: Priced Bill of Quantities (Refer Vol-II)

Schedule -C to Bid

: Proposed Construction Schedule

Schedule -D to Bid

: Method of Performing the Work

Schedule -E to Bid

: List of Major Equipment – Related Items

Schedule -F to Bid

: Organization Chart of the Supervisory
Staff and Labor

Description

Schedule -G to Bid	: List of Subcontractors
Schedule -H to Bid	: Estimated Progress Payments
Schedule -I to Bid	: Construction Camp and Housing facilities
Schedule -J to Bid	: Integrity Pact
Schedule -K to Bid	: Financial Competence and Access to Financial Resources
Schedule -L to Bid	: Past Performance, Current Commitment, Equipment and Personnel Qualification and Experience

FORMS

Form of Bid Security

Form of Performance Security

Letter of Acceptance

Form of Contract Agreement

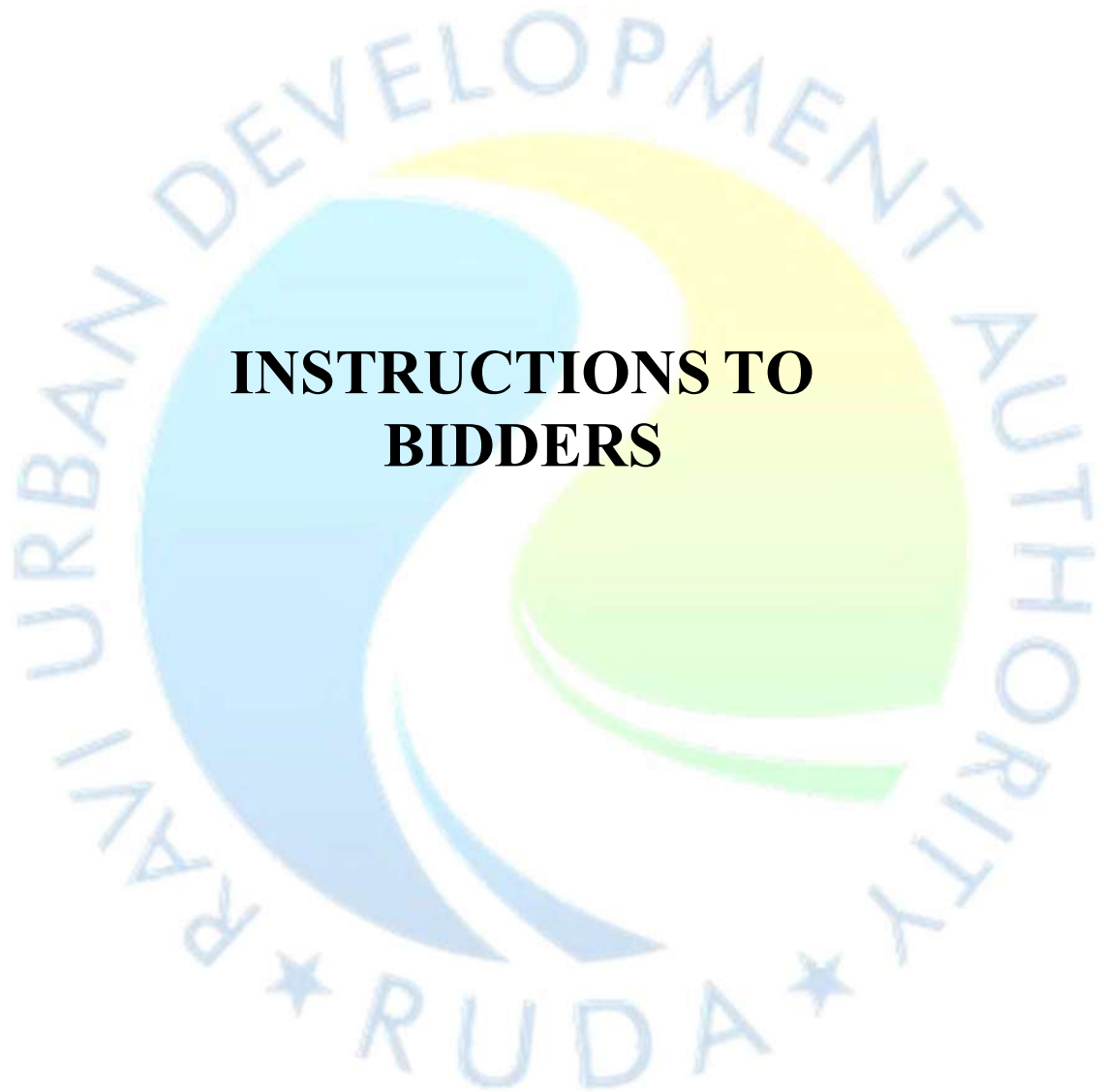
DAAB AGREEMENT

INDEMNITY BOND FOR SECURED ADVANCE AGAINST MATERIAL BROUGHT AT SITE

Part-I: GENERAL CONDITIONS OF CONTRACT (GCC)

Part-II: PARTICULAR CONDITIONS OF CONTRACT (PCC)

- **PART A – CONTRACT DATA**
 - **PART B – SPECIAL PROVISIONS**
- SPECIFICATIONS**
- **PART A – SPECIFIC PROVISIONS**
 - **PART B – TECHNICAL PROVISIONS**
- DRAWINGS**



INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid

- 1.1 The Employer as defined in the Bidding Data hereinafter called the “Employer” 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 ***Bidding Data***.

IB.2 Source of Funds

- 2.1 The Employer has applied for/received a funding from the source(s) in various currencies towards the cost of the project specified in the Bidding Data and it is intended that part of the proceeds of this funding 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 Bidders meeting the following requirements at the time of submission of Bids and thereafter:

- a) Duly eligible for this bidding process;
- b) Duly licensed by the Pakistan Engineering Council (PEC) in the category relevant to the value of the Works in the relevant field of specialization.

However, a Foreign Constructor can submit provisional license with its Bid but the Foreign Constructor will be required to submit standard license after award of Contract and before start of work.

Foreign Constructor shall not be eligible to participate in bidding individually. Foreign Constructor shall enter into joint venture with Pakistani Constructor registered with the Pakistan Engineering Council in equivalent/compatible category and submit the joint venture agreement to the Employer before participating in bidding in accordance with PEC Construction and Operation of Engineering Works Bye-laws, 1987;

- c) Pakistani Constructor must be on Active Taxpayer List of the Federal Board of Revenue and provincial revenue authority/ board where applicable; and
- d) All partners constituting the Bidder including proposed subcontractors do not appear in the list of debarred/ blacklisted firms and individuals on the websites of PEC and Federal & Provincial Procurement Regulatory Authorities and have not been declared debarred/ blacklisted by foreign country, international organizations

or other foreign institutions.

IB.4 Eligible Materials, Equipment and Services

- 4.1 All materials, equipment and services to be supplied under this Contract shall have their origin in eligible countries described under paragraph 4.4 hereunder.
- 4.2 For purpose of this Clause, “origin” means the place where the Goods are mined, grown or produced or from where the ancillary services are supplied. Goods are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.
- 4.3 The origin of Goods and Services is distinct from the nationality of the Bidder.
- 4.4 Eligible countries to participate in this bidding process are those which have been notified by Ministry of Interior, Government of Pakistan as Business Friendly Countries (BVL); information can be accessed through following link:
<http://www.dgip.gov.pk/Files/Visa%20Categories.aspx#L>

IB.5 One Bid per Bidder

- 5.1 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.17) will be disqualified.

IB.6 Site Visit

- 6.1 The Bidders are advised to visit and examine the Site of Works and its surroundings and obtain for themselves on their own responsibility, 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 Employer 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 Employer, 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 expenses incurred as a result of such inspection.

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents

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.

1. Instructions to Bidders;
2. Bidding Data;
3. Evaluation Criteria and Qualification Updating Forms;
4. General Conditions of Contract, (GCC);
5. Particular Conditions of Contract, (PCC);
 - Part A- Contract Data;
 - Part B – Special Provisions;
6. Specifications (SP);
 - Part A – Specific Provisions;
 - Part B – Technical Provisions;
7. Letter of Bid;
8. Schedules to Bid;
9. Standard Forms;
 - i. Form of Bid Security;
 - ii. Letter of Acceptance;
 - iii. Form of Contract Agreement;
 - iv. Form of Performance Security;
 - v. DAAB Agreement;
 - vi. Form of Mobilization Advance Guarantee;
 - vii. Bill of Quantities (Schedule – B to Bid);
10. 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 Bidder's 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 & Pre-Bid Meeting

- 8.1 Any prospective Bidder requiring any clarification(s) in respect of the Bidding Documents may notify the Employer in writing at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which he receives earlier than the period specified in the **Bidding Data**, prior to the deadline for submission of bids.
- 8.2 Copies of the Employer's response will be forwarded to all purchasers of the Bidding Documents, including a description of the enquiry but without identifying its source.
- 8.3 The Employer may on his own or at the request of any prospective Bidder(s), 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, are as stipulated in the **Bidding Data**. All prospective Bidders or their authorized representatives shall be invited to attend such a pre-bid meeting.

- 8.4 The Bidders are requested to submit questions, if any, in writing so as to reach the Employer not later than two (02) days after the proposed pre-bid meeting.
- 8.5 Minutes of the pre-bid meeting, including the text of the questions raised and the replies given, will be transmitted without delay to all purchasers of the Bidding Documents. 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 Employer exclusively through the issue of an Addendum pursuant to Clause IB.9 and not through the minutes of the pre-bid meeting.
- 8.6 Absence at the pre-bid meeting will not be a cause for disqualification of a Bidder.

IB.9 Amendment of Bidding Documents

- 9.1 At any time prior to the deadline for submission of Bids, the Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective 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 purchasers of the Bidding Documents. Prospective Bidders shall acknowledge receipt of each addendum in writing to the Employer.
- 9.3 Such addendum shall be issued not later than number of days prior to the deadline for submission of bids, specified in the Bidding Data. To afford prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may extend the deadline for submission of Bids in accordance with Clause IB.20.

C. PREPARATION OF BIDS

IB.10 Cost of Bidding

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

IB.11 Language of Bid

- 11.1 The Bid and all correspondence and documents related to the Bid exchanged by a Bidder and the Employer shall be in the Bid language stipulated in the **Bidding Data** and Particular Conditions of Contract. Supporting documents and printed literature

furnished by the Bidders may be in any other language provided the same are accompanied by duly certified 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.12 Documents Comprising the Bid

12.1 Each Bidder shall:

- (a) submit duly filled in, signed and stamped Letter of Bid and completed Schedules to Bid as required, including Bill of Quantities, in accordance with Clause IB.18 hereof;
- (b) submit Bid Security in accordance with Clause IB.16 hereof;
- (c) submit alternative proposal, if permissible in accordance with Clause IB.17;
- (d) submit a written power of attorney authorizing the signatory of the Bid to act for and on behalf of the Bidder. The name and position held by each person signing the authorization must be typed or printed below the signature;
- (e) submit the Qualification Updating Forms duly filled in, signed and stamped along with requisite attachments, to establish that the Bidder continues to meet the Eligibility and Qualification Criteria set out in bidding document and as provided in the Section "Evaluation Criteria and Qualification Updating Forms";
- (f) furnish a technical proposal taking into account the various Schedules to Bid, specially the following:

Schedule-C to Bid	Proposed Construction Schedule
Schedule-D to Bid	Method of Performing the Work
Schedule-E to Bid	List of Major Equipment
Schedule-F to Bid	Organization Chart for Supervisory Staff and other pertinent information such as mobilization program etc.

12.2 Bids submitted by a Joint Venture of two (02) or more firms specified in *Bidding Data*, shall comply with the following requirements:

- (a) the bid, and in case of a successful bid, the Form of Contract Agreement shall be signed by all members so as to be legally binding on all partners;
- (b) 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;
- (c) the partner-in-charge shall always be duly authorized to deal with the Employer

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(b) above as well as in the Letter of Bid and in the Form of Contract Agreement (in case of a successful bid); and
- (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 and corresponding duties & responsibilities 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 Employer.

12.3 The Bidder shall also submit proposals of work methods and schedules in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the technical specifications and the completion time referred to in Sub-Clause IB 1.2 hereof.

IB.13 Bid Prices

- 13.1 The price and discount if any quoted by the Bidders in the Letter of Bid and in the Bill of Quantity shall conform to the requirement specified below:
- 13.2 The Bidder shall quote any discounts and the methodology for their application.
- 13.3 If bids are being invited for individual lots (contracts) or for any combination of lots, the Bidders can offer discounts for the individual lots (contracts) as well as for award of more than one Contract and shall specify in their bid.
- 13.4 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole of the Works as described in Sub-Clause IB.1.1 hereof, based on the unit rates and/or prices.
- 13.5 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 Employer when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities.
- 13.6 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to the deadline for submission of bids shall be included in the rates and prices and the total Bid Price submitted by a Bidder.

Additional/reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed/ deducted as per Sub Clause 13.6 [Adjustment for Changes in Laws] of the Conditions of Contract.

- 13.7 The rates and prices quoted by the Bidders are subject to adjustment during the performance of the Contract in accordance with the provisions of Sub-Clause 13.7 [Adjustments for Changes in Cost] of the General Conditions of Contract. The Bidders shall furnish the prescribed information for the price adjustment formulae in Schedule-A to Bid, and shall submit with their bids such other requisite supporting information if required under the said Schedule.

IB.14 Currencies of Bid and Payment

- 14.1 The unit rates and the prices shall be quoted by the Bidder entirely PKR.

A Bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country (referred to as the "Foreign Currency Requirements") shall indicate in Table III of Schedule-A to Bid the proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements; in such case the unit rates and the prices shall be quoted by the Bidder in Equivalent PKR.

- 14.2 The rates of exchange to be used by the Bidder for currency conversion shall be the TT Selling Rates published or authorized by the State Bank of Pakistan prevailing on the date twenty eight (28) days prior to the deadline for submission of bids. Such rates shall be notified by the Employer not later than fourteen (14) 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.15 Bid Validity

- 15.1 Bids shall remain valid for the period stipulated in the **Bidding Data** after the Date of Bid Opening specified in Clause IB.23.
- 15.2 In exceptional circumstances, prior to expiry of the original Bid validity period, the Employer may request that the Bidders extend the period of validity for a specified additional period which shall in no case be more than the original Bid validity period. The request and the responses thereto shall be made in writing. A Bidder may refuse the request without forfeiting his Bid Security. A Bidder agreeing to the request will not be required or permitted to modify his Bid, but will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.16 in all respects.

IB.16 Bid Security

- 16.1 Each Bidder shall furnish, as part of his Bid, a Bid Security in the amount stipulated in

the **Bidding Data** in Pak Rupees or an equivalent amount in a freely convertible currency.

- 16.2 The Bid Security shall be, at the option of the Bidder, in the form of Call Deposit Receipt (CDR)/ Pay Order or a Security issued in the prescribed form included in the Bidding Documents, by (a) a Scheduled Bank in Pakistan or (b) a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan or (c) an Insurance Company listed in the **Bidding Data** and rated by PACRA/VIS of rating as provided in Table below in favour of the Employer valid for a period 14 days beyond the Bid Validity date. The Bid Security of Joint Venture shall be in the name of Joint Venture or Lead/either Firm of the JV or in ratio of shares of the individual JV partners, submitting the bid.

Bid Price (In Eq. million PKR)	Minimum Rating of Insurance Companies
Up to 1000	A (+)
1001 to no limit	AA
<i>[Note: Insurance Company includes Joint Ventures of Insurance Companies also]</i>	

- 16.3 Any Bid not accompanied by an acceptable Bid Security shall be rejected by the Employer as non-responsive.
- 16.4 The Bid Securities of the Bidders except the lowest three will be returned by the Employer within twenty-eight (28) days from the opening of Bids, provided a Bidder requests for the return of its Bid Security, or upon the expiry of original validity of Bid Security or as extended, whichever is earlier.
- 16.5 The Bid Security of the lowest three Bidders including the successful Bidder will be returned when the successful Bidder has furnished the required Performance Security.
- 16.6 The Bid Security may be forfeited:
- If the Bidder withdraws his Bid except as provided in Sub Clause IB 22.1;
 - If the Bidder does not accept the correction of his Bid Price pursuant to Sub Clause IB 28.2 hereof; or
 - In the case of successful Bidder, fails to furnish the required Performance Security.
- 16.7 In case of annulment, all Bids submitted and specially, bid securities, shall be returned to the Bidders within 14 days of annulment.

IB.17 Alternate Proposals by Bidder

- 17.1 Unless otherwise specified in the Bidding Data, alternative proposal(s) shall not be considered.
- 17.2 Should any Bidder consider that he can offer any advantages to the Employer by a modification to the designs, specifications or other conditions, he may, in addition to

his Bid to be submitted in strict compliance with the Bidding Documents, submit any alternative proposal(s) containing

(a) relevant design calculations; (b) technical specifications;
(c) proposed construction methodology; and (d) any other relevant details/conditions, provided always that the total sum entered on the Letter of Bid shall be that which represents complete compliance with the Bidding Documents.

- 17.3 Alternative proposal(s), if any, of the Bidder having submitted most advantageous Bid only may be considered by the Employer as the basis for the award of Contract to such Bidder.

IB.18 Format and Signing of Bid

- 18.1 Bidders are particularly directed that the amount entered on the Letter of Bid shall be for performing the Contract strictly in accordance with the Bidding Documents.

- 18.2 All Schedules to Bid are to be properly completed and signed.

- 18.3 No alteration is to be made in the Letter of Bid nor in the Schedules 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 in the forms completely and without alterations one (1) original and number of copies, specified in the Bidding Data, of the documents comprising the Bid as described in Clause IB.12 and clearly mark them "ORIGINAL" and "COPY" as appropriate. In the event of discrepancy between them, the original shall prevail.

The Bidder shall also provide complete searchable PDF versions as well as Word, Excel, etc. versions of the Bid if so required by the Employer.

- 18.5 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder pursuant to Sub-Clause IB.12.1(d) hereof. All pages of the Bid shall be initialed and stamped by the person or persons signing the bid.

- 18.6 The Bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Employer, or as are necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.

- 18.7 Bidders shall indicate in the space provided in the Letter of Bid, their full and proper 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.

- 18.9 All documents executed outside Pakistan required to be submitted with the Bid must be certified by Pakistani Embassy in the respective country(ies).

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 will be put in one sealed envelope and addressed / identified as given in Sub Clause IB.19.2 hereof.

19.2 The inner and outer envelopes shall:

- (a) Be addressed to the Employer at the address provided in the **Bidding Data**;
- (b) bear the specific identification of this bidding process as specified 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 IB 19.2 hereof, the inner envelope shall indicate the name and 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 Employer 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 Employer at the address specified no 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 will 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 envelope.
 - (d) Upon request, acknowledgment of receipt of Bids will be provided to those making delivery in person or by messenger.

20.2 The Employer may, at his discretion, extend the deadline for submission of Bids by issuing an amendment in accordance with Clause IB.9, in which case all rights and obligations of the Employer and the Bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.21 Late Bids

- 21.1 (a) Any Bid received by the Employer after the deadline for submission of Bids prescribed in Clause IB.20 shall be declared late, rejected and returned unopened to such Bidder.
- (b) Delays in the mail, delays of 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 determine the manner in which timely delivery of his Bid will be accomplished either in person, by messenger or by mail.

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 Employer 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 IB 22.1 and 28.2.
- 22.4 Withdrawal of a Bid during the interval between the deadline 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.16.

E. BID OPENING AND EVALUATION

IB. 23 Bid Opening

- 23.1 The Employer 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' representatives who are present shall sign a register evidencing their attendance.
- 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. Only bids that are opened and read out at Bid opening shall be considered further.
- 23.3 The Bidder's name, total Bid Price and price of any alternative proposal(s), any discounts, Bid modifications, substitution and withdrawals, the presence or absence of Bid security, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening of Bids. Only discounts and alternative

proposals read out at Bid opening shall be considered for evaluation. The Letter of Bid and the Summary Bill of Quantities are to be initialled by representative(s) of the Employer attending Bid opening. The Employer shall neither discuss the merits of any Bid nor reject any Bid (except for late Bids, in accordance with Sub-Clause IB 21.1).

- 23.4 The Employer 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

- 24.1 Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of Contract shall not be disclosed to Bidders or any other person not officially concerned with such process before the announcement of the result of Bid evaluation in the form of final evaluation report giving justification for acceptance or rejection of Bids which shall be done at least fifteen (15) days prior to 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 Employer's processing of Bids or Contract award decisions may result in the rejection of such Bidder's Bid. Whereas any Bidder feeling aggrieved may lodge a written complaint not later than five (5) days after the announcement of the final evaluation report.

IB.25 Clarification of Bids

- 25.1 To assist in the examination, evaluation and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdowns of unit rates and lump sum prices. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The request for clarification and the response shall be in writing. 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 Employer in the evaluation of the Bids in accordance with Clause IB.28.
- 25.2 The Employer may, at his discretion, ask any Bidder for confirmation/submission of missing information to clarify its Bid. However, the Employer does not have an obligation to request any additional information or clarification with respect to missing or deficient information in a Bid. The Employer may reject any Bid as non-responsive if found materially incomplete, obscure, irregular or omitting any material information required to be submitted in accordance with the Bidding Documents.
- 25.3 If a Bidder does not provide clarifications of its Bid by the date and time set reasonably (not less than seven (7) days) in the Employer's request for clarification, the Employer may proceed with the evaluation based on the information submitted in the Bid without waiting for the Bidder's response.

IB.26 Examination of Bids and Determination of Responsiveness

- 26.1 Prior to the comparison of Bids, the Employer will determine whether each Bid is substantially responsive to the requirements of the Bidding Documents.
- 26.2 The Employer's determination of a Bid's responsiveness is to be based on the contents of the Bid itself, as defined in Sub- Clause IB.12.
- 26.3 A substantially responsive Bid is one which meets the requirements of the Bidding Documents, without material deviation, reservation or omission. A material deviation, reservation or omission is one that,
- (a) if accepted, would:
 - (i) affect in any substantial way the scope, quality or performance of the Works; or
 - (ii) limit in any substantial way, inconsistent with the Bidding Documents, the Employer's rights or the Bidder's obligations under the proposed Contract; or
 - (b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive Bids.
- 26.4 During the evaluation of Bids, the following definitions apply:
- (a) "Deviation" is a departure from the requirements specified in the Bidding Documents;
 - (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Documents; and
 - (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Documents.
- 26.5 The Employer shall examine the technical aspects of the Bid submitted in accordance with Sub-Clause IB.12.1(f), in particular, to confirm that all requirements stated in Specifications have been met without any material deviation, reservation or omission.
- 26.6 If a Bid is not substantially responsive to the requirements of the Bidding Documents, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation, reservation or omission.

IB.27 Nonmaterial, Nonconformities

- 27.1 Provided that a Bid is substantially responsive, the Employer may waive any nonconformities in the Bid.
- 27.2 Provided that a Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial, nonconformities in the Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the price of the Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

- 27.3 Provided that a Bid is substantially responsive, the Employer shall rectify quantifiable non-material nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component, by adding the average price of the item or component quoted by other lowest two evaluated substantially responsive Bidders. If the price of the item or component cannot be derived from the price of other substantially responsive Bids, the Employer shall use a suitable CSR, adjusted to the date 28 days earlier to the Bid submission date or its best assessment.

IB.28 Correction of Arithmetic Errors

- 28.1 Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer 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 Employer 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.
 - (c) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.
- 28.2 The amount stated in the Letter of Price Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and with the concurrence of the bidder, 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 IB.16.6 (b) hereof.

IB.29 Evaluation and Comparison of Bids

- 29.1 The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause IB.26. The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.
- 29.2 In evaluating and comparing the Bids, the Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:
- (a) Making any correction for arithmetic errors pursuant to Clause IB.28;
 - (b) price adjustment due to discounts offered in accordance with Sub-Clause IB.23.3;
 - (c) excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including competitively priced daywork;

- (d) making an appropriate price adjustment for any quantifiable nonmaterial nonconformities in accordance with Sub-Clause IB.27.3;
 - (e) the additional evaluation factors are specified in Section Evaluation Criteria and Qualification Updating Forms.
- 29.3 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.

IB.30 Abnormally Low Bids

- 30.1 If the Bid Price of the successful Bidder is more than 15% below the lower of the Employer's estimate of the cost of work to be performed under the Contract or average of other lowest two evaluated substantially responsive Bids, the Employer 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 Employer may require an additional Performance Security by 10% of the difference of the Bid Price as determined hereinabove upto issuance of Taking Over Certificate at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. The Bids having Bid Price lower than 25% shall be liable to be rejected.

IB.31 Unbalanced or Front-Loaded Bids

- 31.1 If the Bid of the successful Bidder is seriously unbalanced (Front Loaded) in relation to the average of other evaluated substantially responsive Bids, the Employer during execution of contract may pay against measured quantities of significantly higher quoted line item(s) rate(s) with respect to same line item(s) rate(s) determined from the average of other lowest two evaluated substantially responsive Bids as instructed by the Engineer. The balance line item(s) rate(s) may be paid against the same measured quantities at the time of issuance of Taking Over Certificate or as instructed by the Engineer.

F. AWARD OF CONTRACT

IB.32 Award Criteria

- 32.1 Subject to Clauses IB.33 and IB.39, the Employer will award the Contract to the Bidder whose Bid has been determined as most advantageous Bid (substantially responsive to requirements of the Bidding Documents with the lowest evaluated Bid Price).

IB.33 Employer's Right to Annul the Bidding Process Bids

- 33.1 Notwithstanding Clause IB.32, the Employer reserves the right to annul the bidding process and reject all Bids, at any time prior to award of Contract, without thereby incurring any liability to the affected Bidders or any obligations.

The Employer shall upon request communicate to any Bidder who submitted a Bid, the

grounds for its rejection of all Bids but is not required to justify those grounds. Rejection of all Bids shall be notified to all Bidders promptly.

IB.34 Notification of Award

- 34.1 Prior to expiration of the period of Bid validity prescribed by the Employer, the Employer will notify the successful Bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Employer will pay 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 "Accepted Contract Amount").

The Letter of Acceptance will also state the remedies with respect to Sub-Clauses IB.30 & IB.31 if applicable.

- 34.2 No negotiation with the Bidder having submitted most advantageous Bid or any other Bidder shall be permitted, however, Employer may have clarification meetings before issuing Letter of Acceptance to get clarified any item in the Bid evaluation report.
- 34.3 The Letter of Acceptance/ notification of award and its acknowledgement/acceptance by the Bidder will constitute the formation of the Contract, binding the Employer and the Bidder till signing of the formal Contract Agreement.
- 34.4 Upon furnishing by the successful Bidder of a Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful and return their Bid securities in accordance with Sub-Clause IB.16.5.

IB.35 Performance Security

- 35.1 The successful Bidder shall furnish to the Employer a Performance Security in the form and the amount stipulated in the Conditions of Contract and additional Performance Security if applicable under IB.30 as stated in the Letter of Acceptance, within a period of 28 days after the receipt of Letter of Acceptance.
- 35.2 Failure of the successful Bidder to comply with the requirements of Sub Clause IB.35.1 or Clauses IB.36 or IB.38 shall constitute sufficient grounds for the annulment of the award, forfeiture of the Bid security and to award the Contract to the Bidder having submitted next advantageous Bid.

IB.36 Signing of Contract Agreement

- 36.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Employer will notify the successful Bidder to depute its representative with appropriate Power of Attorney to sign the Contract Agreement in the form provided in the Bidding Documents, incorporating all agreements between the parties.
- 36.2 The formal Agreement between the Employer and the successful Bidder shall be executed within 14 days of the receipt of the above stated notification by the successful

Bidder from the Employer.

IB.37 Integrity Pact

- 37.1 The Bidder shall sign and stamp the Integrity Pact provided at Schedule-J to Bid in the Bidding Documents for all Punjab Government procurement contracts exceeding PKR ten million. Failure to provide such Integrity Pact shall make the Bidder non-responsive.

IB.38 Instructions not Part of Contract

- 38.1 Bids shall be prepared and submitted in accordance with the Instructions to Bidders which are provided to assist the Bidders in preparing Bids but do not constitute part of the Contract.

IB.39 Corrupt and Fraudulent Practices

- 39.1 The Employer will reject a Bid if it determines that the Bidder recommended for award, or any of its personnel, or its agents, or its sub-contractors, service providers, suppliers and/or their employees, has, directly or indirectly, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for the contract under this bidding.
- 39.2 The Employer will blacklist and hence forthwith debar a Constructor or individual, at any time, in accordance with the prevailing Public Procurement Rules 2004.

Bidding Data

The following specific data for the Works to be bid 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.

IB Clause Reference	Bidding Data
1.1	Name and address of the Employer: Name: <i>Ravi Urban Development Authority (RUDA)</i> Address: <i>Engineering Wing of RUDA, 5-C Muslim Town, Facing Canal, Near Punjab Group of Colleges, Lahore.</i>
1.1	Name of the Project & Summary of the Works: Project: <i>Electrical Works at Chahar Bagh-I</i> Brief summary of work under this contract shall be: • <i>MV & LV Outdoor Electrical Equipment</i> • <i>Power Cables System (MV & LV)</i>
1.2	Time for Completion for the Works: 420 days
1.3	New Sub-Clause 1.3 is added: "Bids shall be invited on <u>Single Stage Two Envelope Bidding Process.</u> "
2.1	Name of the Borrower/Source of Funding: <i>Employer's Own Sources</i>
3.1	Sub-paras (a) to (d) are deleted in their entirety and substituted with the following: - Bids are invited according to Rule 25 of RUDA Procurement Regulations 2022 (amended) ; - Duly licensed by the Pakistan Engineering Council (PEC) in Category C-A or above having specialization in codes: "CE-10, EE-04, EE-05, EE-11 (General Electrical Works Only)". - Foreign Constructor must submit atleast provisional license with its Bid but the Foreign Constructor will be required to submit standard license after award of Contract and before start of work. Foreign Constructor shall not be eligible to participate in bidding individually. Foreign Constructor shall enter into joint venture with Pakistani Constructor registered with the Pakistan Engineering Council in equivalent/compatible category and submit the joint venture agreement to the Employer before participating in bidding in accordance with PEC Construction and Operation of Engineering Works Bye-laws, 1987; - In addition to above, bidders should meet the following

	eligibility criteria: - Registration with Income Tax & Sales Tax Department (valid income tax & Sales Tax certificate is required); - Firm(s) should not have Litigation History in which Decision has been given against the firm(s); The Firm(s) shall not be eligible to participate if debarred / blacklisted by any Government / Semi Government / Public Department / International Body(ies); e) Bidder (Single Entity /JV /Consortium of two or more members) must meet qualification requirements given in Schedules K & L to Bid. Minimum 65% marks are necessary in each category and Minimum 70% overall marks are necessary for qualification. If firm / company or organization formed as JV or Consortium of two or more members, wishes to Bid, the lead member must secure minimum 50% marks in each category of Schedule-K and Schedule-L to Bid. <u><i>Note: The Bidder (Single Entity /JV/Consortium of two or more members), must fulfil all the specialized codes collectively as mentioned in sub-para 3.1(b) and must fulfil sub-para 3.1(d) & 3.1(e) individually, by each member of JV/Consortium of two or more members.</i></u>
7.1	Words 'Letter of Bid' appearing at number 7 is replaced with "Letter of Technical Bid and Letter of Price Bid". The following document is added at the end: 11. Environmental Management Plan.
8.1	Time limit for clarification: <i>04 days before deadline for submission of Bids.</i>
8.3	Venue, time, and date of the Pre-Bid meeting: <i>As mentioned in an advertisement / invitation for bids (IFBs)</i>
9.3	Number of days: <i>04 days</i>
11.1	Bid language: <i>The language of the Bidding Documents is English.</i>
12.1	In sub-para (a), words 'Letter of Bid' are replaced with "Letter of Technical Bid and Letter of Price Bid".

	Following Schedules are added in sub-para (f). “Schedule-K to Bid: Financial Competence and Access to Financial Resources Schedule-L to Bid: Past Performance, Current Commitment, Equipment & Personnel Qualification and Experience”
12.1 (A)	The following text is added: The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the document as listed under para (1) and the other called the Price Bid containing the documents listed in para (2) hereunder. (1) Technical Bid Shall comprise the following documents - <i>Letter of Technical Bid</i> - <i>Bid Security</i> IB.16 - <i>Written confirmation authorizing the signatory of the Bid to commit the Bidder</i> IB.18 - <i>Pending litigation information</i> On Rs. 200 E-stamp paper - <i>Proposed Construction Schedule</i> Schedule – C to Bid - <i>Method of Performing the Work (as filled by Bidder)</i> Schedule – D to Bid - <i>List of Major Equipment – Related Items (as filled by Bidder)</i> Schedule – E to Bid - <i>Construction Camp and Housing Facilities(as filled by Bidder)</i> Schedule – I to Bid - <i>List of Sub-contractors (as filled by the Bidder)</i> Schedule – G to Bid - <i>Organization Chart for Supervisory Staff (as filled by Bidder)</i> Schedule – F to Bid - <i>Integrity Pact</i> Schedule – J to Bid - <i>Financial Competence and Access to financial Resources</i> Schedule – K to Bid - <i>Past Performance, Current Commitment,</i> Schedule – L to Bid

	<i>Equipment &</i> - <i>Personnel Qualification and Experience</i> - <i>General Conditions (GC)</i> - <i>Particular Conditions (PC)</i> <i>Part A – Contract Data</i> - <i>Particular Conditions (PC)</i> <i>Part B – Special Provisions</i> - <i>Specifications Part A - Specific Provisions</i> - <i>Specifications Part B - Technical Provisions</i> - <i>Drawings</i> (2) Price Bid Shall comprise the following documents - <i>Letter of Price Bid</i> - <i>Foreign Currency Requirement</i> - <i>Schedule of Adjustment Data</i> - <i>Schedule of Adjustment Data</i> - <i>Bill of Quantities</i> - <i>Estimated Progress Payment</i>	<i>Refer Volume-I</i> <i>Refer Volume-I</i> <i>Refer Volume-I</i> <i>Refer Volume-III</i> <i>Refer Volume-III</i> <i>Refer Volume-IV</i> <i>Not Used</i> <i>A-1</i> <i>Schedule – A to Bid</i> <i>A-2</i> <i>Schedule – A to Bid</i> <i>Schedule – B to Bid (Refer Volume – II)</i> <i>Schedule – H to Bid</i>
12.2	Maximum number of JV / Consortium Members shall be 03 (Three Nos.)	
12.3	Sub-clause is deleted in its entirety and replaced with the following: “The Bidder shall furnish, as part of the Technical Bid, a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Bidding Forms, in sufficient detail to demonstrate the adequacy of the Bidder’s proposal to meet the work requirements and the completion time referred to in Sub-Clause 1.2 hereof.”	
12.4	New Sub-clause is added: “The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid and the other the Price Bid, containing the documents as listed under Sub – Clause 12.1(A) above. Both envelopes are to be enclosed together in an outer single envelope	

	called the Bid. Each Bidder shall furnish all the documents as specified in Bidding Data 12.1(A)."
13.1	Words 'Letter of Bid' appearing in second line are replaced with "Letter of Price Bid".
14.1	Second para is deleted in its entirety. Bidders to quote entirely in Pak. Rupees. Foreign Currency Requirements are not applicable.
14.2	The Text of whole sub-clause is deleted and substituted with the following: For the purpose of payment, payment shall be made entirely in PKR Rupees.
15.1	The Bids shall remain valid for 90 days after the date of opening of Bid.
16.1	Amount of Bid Security: (Rs. 40,000,000/-)
16.2	Sub-clause is deleted in its entirety and replaced with the following: "The Bid Security shall be in the form of (a) a Scheduled Bank in Pakistan or (b) a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan in favour of the Employer valid for a period 28 days beyond the Bid Validity date. The Bid Security of Joint Venture shall be in the name of Joint Venture or Lead Firm on behalf of the JV."
16.4	Sub-clause is deleted in its entirety and replaced with the following: "The Bid securities of unsuccessful Bidders will be returned as promptly as possible, but not later than 28 days after the expiration of the period of Bid Validity."
16.5	Sub-clause is deleted in its entirety and replaced with the following: The Bid Security of the successful Bidder will be returned as promptly as possible when the Bidder has furnished the required Performance Security and signed the Contract Agreement.
16.6	Sub-clause (c) is deleted in its entirety and replaced with the following: In the case of successful Bidder, fails within the specified time limit to: (i) Furnish the required Performance Security; (ii) Sign the Contract Agreement. (iii) Furnish the required JV agreement (if applicable) within 7 days of the receipt of letter of acceptance."
17	<i>Alternative Proposal(s) by the Bidder shall not be considered.</i>

18.1	Words 'Letter of Bid' are replaced with "Letter of Price Bid".
18.3	Words 'Letter of Bid' are replaced with "Letter of Technical Bid and Letter of Price Bid".
18.4	Sub-clause is deleted in its entirety and replaced with the following: "The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in Bidding Data against IB.12 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID". In addition, the Bidder shall submit two (02) number of copies of the Bid as given in the Bidding Data and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail. The envelope containing the Price Bid shall also be marked with a caution: "Not to be opened unless the Technical Bid is opened". The Bidder shall also provide complete searchable PDF versions as well as Word, Excel, etc. versions of the Bid if so required by the Employer."
18.7	Words 'Letter of Bid' are replaced with "Letter of Technical Bid and Letter of Price Bid".
19.1	Sub-para (c) is added: c) The Technical Bid should comprise the documents listed in BD 12.1 (A)(1) & the Price Bid listed in BD 12.1 (A)(2) which shall be placed in separate envelopes in accordance with IB 12.1".
19.2(a)	Employer's address for the purpose of Bid submission: The Bids shall be submitted at the address of Engineering Wing of RUDA,5-C Muslim Town, Facing Canal, Near Punjab Group of Colleges, Lahore.
19.2(b)	Name and Number of the Contract: Name: Electrical Works at Chahar Bagh-I
19.2(c)	Warning: Not to open before the time and date set for bid opening.
20.1(a)	Deadline for submission of Bids: As mentioned in the advertisement / invitation for bids (IFBs)
23	IB 23 is deleted in its entirety and following new sub-clauses are added: 23.1 The Employer will open the Technical Bids in public at the address, date and time specified in the Bidding Data in the presence of Bidders' designated representatives and anyone who choose to attend. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening.

	23.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened but returned to the Bidder. No Bid withdrawal shall be permitted unless the corresponding Withdrawal Notice contains a valid authorization to request the withdrawal and is read out at Bid opening. 23.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with IB.22. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at Bid opening. 23.4 Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original and Modification, will remain unopened in accordance with IB 23.1. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders. 23.5 Other envelopes holding the Technical Bids shall be opened one at a time, and the following are read out and recorded: - the name of the Bidder; - whether there is a modification or substitution; - the presence of a Bid Security, if required; and - Any other details as the Employer may consider appropriate. No Bid shall be rejected at the opening of Technical Bids except for late Bids, in accordance with IB 21.1. Only Technical Bids read out and recorded at Bid opening, shall be considered for evaluation. 23.6 Preliminary Examination of Technical Bids - Prior to the detailed technical evaluation of bids, the Employer will determine the basic eligibility requirement set out under sub-clause BD 3.1. The bidder qualifying the requirements mentioned under sub-clause BD 3.1 shall be considered as substantially responsive and shall be considered for detailed technical evaluation. - The Employer shall then examine qualification and experience Data as per Schedule-K & L to Bid submitted by the Bidder. The Technical Bid examination of those Bidders only shall be taken in hand who meet the minimum requirement as mentioned in Schedule-K & L to Bid.
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	(b) The Employer shall examine the Technical Bid to confirm that all the documents have been provided as per sub-clause BD 12.1(A)(1), and to determine the completeness of each document submitted. 23.7 The Employer shall confirm that all the documents and information have been provided for evaluation of Technical Bid as required under these Bidding documents. 23.8 At the end of the evaluation of the Technical Bids, the Employer will invite only those Bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice for the opening of Price Bids. 23.9 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being non-responsive to the requirements of the Bidding Document and return their Price Bids unopened before inviting others, who are determined as being qualified, to attend the opening of Price Bids. 23.10 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, publicly in the presence of Bidders' representatives who choose to attend at the address, date and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance. 23.11 All envelopes containing Price Bids shall be opened one at a time and the following are read out and recorded: (a) The name of the Bidder; (b) Whether there is a modification or substitution; (c) The Bid Prices, including any discounts and alternative offers (if permissible); and (d) Any other details as the Employer may consider appropriate. Only Price Bids and discounts, read out and recorded during the opening of Price Bids shall be considered for evaluation. No Bid shall be rejected at the opening of Price Bids. 23.12 If this Bidding Document allows Bidders to quote separate prices for different contracts, and the award to a single Bidder of multiple contracts, the methodology to determine the lowest evaluated price of the contract combinations is that which is most economical to the Employer. 23.13 The Employer shall prepare minutes of the Bid opening of Technical and Price Bids, including the information disclosed to those present in accordance with the Sub-Clauses IB.23.5 & 23.11.
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26.3	Text of opening sub-clause is amended as under: “A substantially responsive Bid is one which (i) meets the eligibility requirements as per Clause IB.3.1 (ii) contains all the documents as given in Sub-Clause IB.12.1(A) of the Bidding Data (iii) includes signed Integrity as per Clause IB.37 (iv) conforms to all the terms and conditions and specifications of the Bidding Documents, without material deviation, reservation or omission. A material deviation is one that:”
39.2	In last line words ‘prevailing Public Procurement Rules 2004’ are replaced with “relevant RUDA Procurement Regulations “
40	The following clause is added: IB. 40 General Performance of the Bidders 40.1 The Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Employer may in case of consistent poor performance of any Bidder as reported by the employers of the previously awarded contracts, interalia, reject his bid and/or refer the case to the Pakistan Engineering Council (PEC). Upon such reference, PEC in accordance with its rules, procedures and relevant laws of the land take such action as may be deemed appropriate under the circumstances of the case including blacklisting of such Bidder and debarring him from participation in future bidding for similar works.”



EVALUATION CRITERIA AND QUALIFICATION UPDATING FORMS

Bidders Qualification Updating Forms

To establish its qualifications to perform the contract in accordance with Section (Evaluation Criteria and Qualification Updating Forms) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.





Form ELI -1.1

Bidder Information Form

Date:

Bid Reference No. (if any) and title:

Page _____ of _____ pages

Bidder's name
In case of Joint Venture (JV), name of each member:
Bidder's country of registration:
Bidder's year of incorporation:
Bidder's legal address:
Bidder's authorized representative information Name: _____ Address: _____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents, in case of JV, JV agreement, in accordance with Sub-Clause IB 3.1.



Form ELI -1.2

Bidder's JV Information Form

(to be completed for each member of Bidder's JV)

Date:

Bid Reference No. (if any) and title:

Page.....of pages

Bidder's JV name:
JV member's name:
JV member's country of registration:
JV member's year of constitution:
JV member's legal address in country of constitution:
JV member's authorized representative information Name: _____ Address: _____ Telephone/Fax numbers: _____ E-mail address: _____



Form CON – 1

Pending Litigation

Bidder's Name:.....

Date:

JV Member's Name:.....

Bid Reference No. (if any) and title:.....

Page of.....pages

Pending Litigation, in accordance with Eligibility and Qualification Criteria			
Year of dispute	Amount in dispute (currency)	Contract Identification	Total Contract Amount (currency), Eq. PKR (exchange rate)
		Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
		Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	

Form FIN – 3.1:

Financial Situation and Performance

Bidder's Name:

Date:.....

JV Member's Name:.....

Bid Reference No. (if any) and Title:.....

Page.....of pages

• Financial Data

Type of Financial information in (currency)	Historic information for last year, (amount in currency, currency, exchange rate*, Eq. PKR)
Statement of Financial Position (Information from Balance Sheet)	
Total Assets (TA)	
Total Liabilities (TL)	
Total Equity/Net Worth (NW)	
Current Assets (CA)	
Current Liabilities (CL)	
Working Capital (WC)	
Information from Income Statement	
Total Revenue (TR)	
Profits Before Taxes (PBT)	
Cash Flow Information	
Cash Flow from Operating Activities	

• Financial documents

The Bidder and its parties shall provide copies of financial statements for last year pursuant to Eligibility and Qualification Criteria, Sub-factor 3.1. The financial statements shall:

- reflect the financial situation of the Bidder or in case of JV member, and not an affiliated entity (such as parent company or group member).
- be independently audited or certified in accordance with local legislation.



- (c) be complete, including all notes to the financial statements.
- (d) correspond to accounting periods already completed and audited.
- Attached are copies of financial statements¹ for the last year required above; and complying with the requirements.
- If the most recent set of financial statements is for a period earlier than 12 months from the date of bid, the reason for this should be justified.



Form FIN – 3.2:

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as specified in Eligibility and Qualification Criteria.

Financial Resources		
No.	Source of financing	Amount (Eq. PKR)
1		
2		
3		

Form FIN – 3.3:

Current Contract Commitments / Works in Progress

Bidders and each member to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments					
No.	Name of Contract	Employer's Contact Address, Tel, Fax	Value of Outstanding Work [Current Eq. PKR]	Estimated Completion Date	Average Monthly Invoicing Over Last Six Months [Eq. PKR /month]
1					
2					
3					
4					
5					



**LETTER OF TECHNICAL BID
&
LETTER OF PRICE BID
AND
SCHEDULES TO BID**

LTB-1

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 as per 12.1(A)(1) provided in **Bidding Data**, including Addenda issued in accordance with Instructions to Bidders (IB) 9 for the execution of Works;
- (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 Price 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) We meet the eligibility requirements in accordance with IB.3.
- (e) We, including any Subcontractors for any part of the Contract, are not debarred/ blacklisted by the Employer, any Government/Semi Government/Public Department in Pakistan or foreign country, international organizations or other foreign institutions.
- (f) Our subcontractors or suppliers for any part of the Contract, if any, shall have nationalities from eligible countries, in accordance with IB.4.4.
- (g) We understand that all the Schedules attached hereto form part of this Bid.
- (h) We 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 Contract Data.
- (i) We agree to abide by this Bid for the period of days, inclusive of days beyond Bid validity period as mentioned in and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
- (j) 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.
- (k) We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other Bidder for the Works.
- (l) 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**, which is valid (at least) 28 days beyond validity of Bid itself.
- (m) We undertake that all the information and documents submitted with the Bid are genuine, and in case of incorrect information of fake documents we shall be liable for punitive action under the Applicable Law.
- (n) 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 IB17 (as applicable).



LTB-2

- (o) 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.12.1 (A)(1) of the **Bidding Data**.

Name

In the capacity of

Signed

Duly authorized to sign the Bid for and on behalf of

Date

Address



Letter of Price 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 as per 12.1(A)(2) provided in Bidding Data, including Addenda issued in accordance with Instructions to Bidders (IB) 9 for the execution of Works;
- (b) The total price of our Bid, excluding any discounts offered in item (c) below is:
- (c) The discounts offered and the methodology for their application are:
- (d) Our Bid shall be valid for a period of days from the date fixed for the bid submission deadline in accordance with the **Bidding Data**, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (e) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents as specified in **Bidding Data**;
- (f) We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed and we do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.
- (g) We understand that you are not bound to accept the lowest evaluated Bid or any other Bid that you may receive.
- (h) 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.12.1 (A)(1) of the **Bidding Data**.



(i) If awarded the contract, the person named below shall act as Contractor's Representative.

Name

In the capacity of

Signed

Duly authorized to sign the Bid for and on behalf of

Date

Address.....



A-1

Schedule – A to Bid

SCHEDULE OF ADJUSTMENT DATA

Schedule of Indexation

The source of indices and the weightages or coefficients for use in the adjustment formula under Schedule shall be as follows:

$$P_n = \{a + b \cdot (L_n/L_o) + f \cdot (D_n/D_o) - 1\}$$

where:

“P_n” is the adjustment multiplier to be applied to the estimated Contract value in the relevant currency of the work carried out in period “n”, this period being a month;

“a” is a constant, representing the non-adjustable portion in contractual payments;

“b” and “f” are coefficients representing the estimated proportion of each cost element related to the execution of the Works as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labour, equipment and materials;

L_n & D_n are the current cost indices or reference prices for period “n”, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 28 days prior to the last day of the period (to which the particular Payment Certificate relates); and

L_o and D_o are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

The weightings (coefficients) for each of the factors of cost stated in the following table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variation(s).

If the Contractor fails to complete the Works within the Time for Completion prescribed under Clause 8.2, adjustment of prices thereafter until the date of completion of the Works shall be made using either the indices or prices relating to the prescribed time for completion, or the current indices or prices, whichever is more favorable to the Employer, provided that if an extension of time is granted pursuant to Clause 8.5, the above provision shall apply only to adjustments made after the expiry of such extension of time.

The weightages for each of the factors of cost given in Schedule of Adjustment Data (Schedule – A to Bid) shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced, or inapplicable as a result of varied or additional work executed or instructed under Clause 12.3. Such adjustment(s) shall have to be agreed in the variation order.

A-2

Schedule-A to Bid

SCHEDULE OF ADJUSTMENT DATA

Table I. Local Currency (LC) For Bill Nos. _____

Cost Element	Description	Coefficients	Weightages (%)	Applicable index
1	2	3	4	5
(i)	Fixed Portion	a	30	
(ii)	Labor Unskilled (L)	b	35	Market Rates of "Materials, labours and machinery" for price variation notified monthly by Finance Department, Govt. of the Punjab for city of Lahore.
(iii)	High Speed Diesel (D)	f	35	The source of prices of HSD shall be either Statistical Bulletin notified monthly by Finance Department, Govt. of Punjab or Pakistan State Oil (PSO) or Oil and Gas Regulatory Authority (OGRA).
	Total		100	

Notes:

- Indices for "(ii)" to "(iii)" shall be taken from "Finance Department published by Government of Punjab" for the city of Lahore.

The base date price (or base date index) of any element shall be the price of the element for the month on the day falling 28 days prior to the latest day for submission of bids.

The current date price (or current date index) of any element shall be the price of the element for the month falling on the 28 days prior to the last day of the period to which the particular Payment Certificate relates.



A-3

Schedule-A to Bid

SCHEDULE OF ADJUSTMENT DATA

Table II. Foreign Currency (FC) For Bill Nos. _____

Not Applicable





A-4

Schedule-A to Bid

SCHEDULE OF ADJUSTMENT DATA

Table III. Foreign Currency Requirements

Not Applicable





A-5

Schedule-A to Bid

SCHEDULE OF ADJUSTMENT DATA

Table IV. Summary of Payment Currencies

Not Applicable





B-1

Schedule – B to Bid

BILL OF QUANTITIES

Please Refer to Volume – II



C-1
Schedule-C to Bid

CONSTRUCTION SCHEDULE

Pursuant to Sub-Clause 8.3 of the General Conditions, the whole of the Works, and each Section (if any), shall be completed within the Time for Completion for the Works or Section (as the case may be) stated as hereunder and mentioned in Contract Data. The Bidder shall provide as Schedule -C to Bid, the Construction Schedule in the bar chart (*CPM or PERT*) 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 his proposed programme for completion of the whole of the Works and Sections of the Works may meet Employer's completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence. (Attach sheets as required for the specified form of Construction Schedule):

Description	Time for Completion (days)
a) Whole Works	
b) Section A	
c) Section B	
d) _____	
e) _____	

D-1
Schedule-D 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:**
Shall indicate 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. **Method of executing the Works:**
The procedures for installation of equipment and machinery and transportation of equipment and materials to the site.



E-1
Schedule-E to Bid

LIST OF MAJOR EQUIPMENT

The Bidder will provide on Sheet E-2 of this Schedule 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.

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Sheet E-3.





E-2
Schedule-E to Bid

LIST OF MAJOR EQUIPMENT

Owned, Purchased or Leased

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						

E-3
Schedule-E to Bid

LIST OF MAJOR EQUIPMENT

Equipment details

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	
The following information shall not be applicable for equipment owned by the Bidder		
Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	



F-1
Schedule-F to Bid

ORGANIZATION CHART
FOR THE
SUPERVISORY STAFF AND LABOUR





G-1
Schedule-G 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

H-1
Schedule-H 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 PKR. Bidders are instructed to provide percentage (%) of bid price in each quarter.

Quarter	Percentage (%) of Contract Amount
1 st	
2 nd	
3 rd	
4 th	
5 th	

Note: Bidders must **not** quote amounts in the above table.

I-1
Schedule-I to Bid

CONSTRUCTION CAMP AND HOUSING FACILITIES

The Bidder 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) Electrical 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 out this activity).
5. Other Items Proposed (Security services, etc.)

1. Note:

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.



J-1

Schedule – J to Bid

**(INTEGRITY PACT)
DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC.
PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN
CONTRACTS WORTH RS. 10.00 MILLION OR MORE**

Contract No. _____ Dated _____
Contract Value: _____ (not to be mentioned at the time of bid submission)
Contract Title: _____

..... [Name of Supplier] 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 Pakistan (GoP) or any administrative subdivision or agency thereof or any other entity owned or controlled by GoP through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Supplier] 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, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether 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 GoP, except that which has been expressly declared pursuant hereto.

[name of Supplier] certifies 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 GoP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Supplier] 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 GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [name of Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

Name of Buyer:
Signature:
[Seal]

Name of Seller/Supplier:
Signature:
[Seal]

K – 1

Schedule – K to Bid

FINANCIAL COMPETENCE AND ACCESS TO FINANCIAL RESOURCES

1. SOUNDNESS AND ACCESS TO FINANCIAL RESOURCES

Sr. #	DESCRIPTION	MAX MARKS	REMARKS
i)	Available Bank Credit Line Limit a) 6 Marks if the available bank credit line limit is equal to Rs. 800 Million. b) No marks for less than Rs.800 Million. c) For the limit of more than Rs.800 Million but less than Rs.1000 Million use following weight age $6 + (A/1000) \times 9$ A= Available Bank Credit Line Limit in Million Rs. d) Full Marks are given in case of credit line limit is Rs.1000 Million or more.	15	No marks if bank credit line certificate is not attached. [The Bank Credit Line Limit certificate must not be more than Six (06) months old]
ii)	Average Working Capital a) 6 Marks if the average working capital in last three years is equal to Rs.800 Million. b) No marks for less than Rs. 800 Million. c) For the capital more than Rs.800 Million but less than Rs.1000 Million use following weight age $6 + (A/1000) \times 4$ A= Average working capital in last three years in Million Rs. d) Full Marks are given in case capital is Rs.1000 Million or more.	10	No marks if Annual Audit Report of last three years duly certified from Chartered Accountant is not attached.
iii)	BID CAPACITY a) $[5 \times \text{working capital} + \text{Project/General specific lines of credit} - 40\% \text{ of current contract commitments}] \geq \text{Bid Price}$	10	Net Bid Capacity = Available capital - 20% of the cost of all balance works in hand Available Capital = Available Bank credit line + Average working capital of last three years as per annual audit report. NOTE: Cost of balance works in hand should be attached, if cost of balance works is not given then total cost of the given works in hand will be considered for evaluating net bid capacity. Zero marks for negative bid capacity.
	Sub-Total of Financial Position	35	

2. **AVERAGE ANNUAL TURNOVER**

Bidders to list their certified annual turnover (audited statements for last three years). **The Audited Statements must not be older than last 05 years.**

Note:

- *For qualification of the Bidder (Single Entity/JV/Consortium), Minimum 65% marks are necessary in each category and Minimum 70% overall marks are necessary for qualification requirement as per criteria given in Schedules – K & L to Bid.*
- *In case of JV/Consortium, the lead member must secure at least 65% marks in each category. If Lead partner fails to achieve the minimum 65% passing marks in any category of Schedule K & L will not be evaluated further and will be considered as technically failed overall.*



L – 1

Schedule – L to Bid

**PAST PERFORMANCE, CURRENT COMMITMENT, EQUIPMENT & PERSONNEL
QUALIFICATION AND EXPERIENCE**

1. PAST PERFORMANCE AND CURRENT COMMITMENTS

Sr. #	DESCRIPTION	MAX MARKS	REMARKS
i)	Projects of similar nature and complexity (MV & LV Outdoor Electrical Equipment and MV & LV Power Cables System) completed over last 10 years 10 marks for MV & LV Outdoor Electrical Equipment (800 million) 10 marks for Power Cables System MV & LV (500 million) <i>Note: at least 02 (two) projects in each sub-category i.e., (a to b) is mandatory, proportionate marking for less than 3 projects encompassing each sub-category, full marks for 2 or more projects encompassing each sub-category (5 marks for each sub-category of project).</i> Explanation: Category-a: 1st project = 5 marks 2nd project = 5 marks Category-b: 1st project = 5 marks 2nd project = 5 marks	20	No marks if Completion Certificate or Performance Certificate or Taking Over Certificate issued by the Client is not attached. Each project proposed by the bidder can cover all the categories as mentioned (a) to (b). In case a single project does not cover all the relevant categories i.e. (a) to (b), proportionate marks will be awarded accordingly. Each Single firm should individually meet the minimum amount of works mentioned in categories i.e. (a) to (b). (Attach list of similar nature and complexity of projects along with certificates issued by the employer with project worth). Note: Cost of relevant categories should be clearly mentioned and highlighted in the summary page of price BOQ issued by the Client.
ii)	Projects of similar nature and complexity (MV & LV Outdoor Electrical Equipment and MV & LV Power Cables System) in hand: 7.5 marks for MV & LV Outdoor Electrical Equipment (800 million) 7.5 marks for Power Cables System MV & LV (500 million) <i>Note: at least 02 (two) projects in each sub-category i.e., (a to b) is mandatory, proportionate marking for less than 2 projects encompassing each sub-category, full marks for 2 or more projects encompassing each sub-category (3.75 marks for each sub-category of project).</i>	15	No marks if Acceptance Letter or Letter of Award issued by the Client is not attached. Each project proposed by the bidder shall cover all the categories as mentioned (a) to (b). In case a single project does not cover all the relevant categories i.e. (a) to (b), proportionate marks will be awarded accordingly. Each Single firm should individually meet the minimum amount of works mentioned in categories i.e. (a) to (b). (Attach list of similar nature and complexity of projects along with

	<u>Explanation:</u> Category-a: 1st project = 3.75 marks 2nd project = 3.75 marks Category-b: 1st project = 3.75 marks 2nd project = 3.75 marks		certificates issued by the employer with project worth). <i>Note: Cost of relevant categories should be clearly mentioned and highlighted in the summary page of price BOQ issued by the Client.</i>
	Total Marks of Working Experience	35	

Note:

- For qualification of the Bidder (Single Entity/JV/Consortium), Minimum 65% marks are necessary in each category and Minimum 70% overall marks are necessary for qualification requirement as per criteria given in Schedules – K & L to Bid.
- In case of JV/Consortium, the lead member must secure at least 65% marks in each category. If Lead partner fails to achieve the minimum 65% passing marks in any category of Schedule K & L will not be evaluated further and will be considered as technically failed overall.

L – 2
Schedule – L to Bid

2. EQUIPMENT

Sr. #	DESCRIPTION	MAX MARKS	REMARKS
1	Hydraulic Jacks (4 Nos.)	1	
2	Cable Drum Trailers (3 Nos.)	1	
3	Cable Pulling Winches (3 Nos.)	1	
4	Hydraulic Cable Drum Jacks (4 Nos.)	1	
5	Mobile Cranes (2 Nos.)	1	
6	Boom Trucks (3 Nos.)	1	
7	Telehandlers (3 Nos.)	1	
8	Earth Resistance Testers (5 Nos.)	1	
9	Excavator (3 Nos.)	1	
10	Trenchers (4 Nos.)	1	
11	Backhoe Loaders (3 Nos.)	1	
12	Directional Drilling Machines (3 Nos.)	1	
13	Cable Fault Locators (3 Nos.)	1	
14	Dumpers (2 Nos.)	1	
15	Tractor Trolley (4 Nos.)	0.5	
16	Water Bowser (2 No)	0.5	
	Sub-Total of Tools & Plants	15	



Note:

- *For qualification of the Bidder (Single Entity/JV/Consortium), Minimum 65% marks are necessary in each category and Minimum 70% overall marks are necessary for qualification requirement as per criteria given in Schedules – K & L to Bid.*
- *In case of JV/Consortium, the lead member must secure at least 65% marks in each category. If Lead partner fails to achieve the minimum 65% passing marks in any category of Schedule K & L will not be evaluated further and will be considered as technically failed overall.*



L – 3

Schedule – L to Bid

3. PERSONNEL QUALIFICATION AND EXPERIENCE

Sr. #	DESCRIPTION	MAX MARKS	REMARKS
i)	Graduate Engineers		
	01 Nos. Project Manager (Professional Electrical Engineer) registered with PEC each having at least 20 years of overall experience & minimum 15 years relevant experience. (02 marks)	2	Add CV's / attached PEC verification / proof of employment with firm. No marks if required documents are not attached.
a	02 Nos. of Professional Electrical Engineer with at least 15 years of overall experience each. (03 marks for each)	6	Add CV's / attached PEC verification / proof of employment with firm. No marks if required documents are not attached.
b	02 Nos. of Registered Electrical Engineer with at least 05-years of experience. (01 mark for each)	2	Add CV's / attached PEC verification / proof of employment with firm. No marks if required documents are not attached.
d	01 Nos. of Registered Civil Engineer with at least 5-years of experience. (1 mark)	1	Add CV's / attached PEC verification / proof of employment with firm. No marks if required documents are not attached.
ii)	DAE Associate Engineers		
a	- Associate Engineers (DAE) with at least 10 years' experience: 08 No. Electrical (0.25 mark for each) 02 No. Civil (0.5 mark for each)	3	Add CV's / proof of employment with firm. No marks if required documents are not attached.
b	04 Nos. of Surveyors (At least 01 Year diploma/certificate) with at least 5 years of experience (0.25 Marks for each)	1	Add CV's / proof of employment with firm. No marks if required documents are not attached.
	Sub-Total of Personnel Capabilities	15	

Note: No marks if required documents are not attached.

- For qualification of the Bidder (Single Entity/JV/Consortium), Minimum 65% marks are necessary in each category and Minimum 70% overall marks are necessary for qualification requirement as per criteria given in Schedules – K & L to Bid.
- In case of JV/Consortium, the lead member must secure at least 65% marks in each category. If Lead partner fails to achieve the minimum 65% passing marks in any category of Schedule K & L will not be evaluated further and will be considered as technically failed overall.



STANDARD FORMS

BID SECURITY

PERFORMANCE SECURITY

LETTER OF ACCEPTANCE

CONTRACT AGREEMENT

DAAB AGREEMENT

FORM OF ADVANCE PAYMENT GUARANTEE

**INDEMNITY BOND FOR SECURED ADVANCE
AGAINST MATERIAL BROUGHT AT SITE**

BS-1

FORM OF BID SECURITY

Security Executed on
(Date)

Expiry on
(Date)

Name of Surety with Address:

Name of Principal (Bidder) with Address

Penal Sum of Security PKR.....(Pak Rupees
.....)

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 'Employer') 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
.....Particulars of Bid) to the said Employer; and

- (1) WHEREAS, the Employer has required as a condition for considering said Bid that the Bidder furnishes a Bid Security in the above said sum to the Employer, conditioned as under: that the Bid Security shall remain in force for a period twenty-eight (28) days beyond the Bid Validity date i.e., upto.....
- (2) that the Bid Securities of the Bidders except the lowest three will be returned by the Employer within twenty eight (28) days from the opening of Bids, provided a Bidder request for the return of its Bid Security, or on the expiry of original validity of Bid Security or as extended, whichever is earlier;
- (3) that the Bid Security of the lowest three Bidders comprising the successful Bidder will be returned when the successful Bidder has furnished the required Performance Security; and
- (4) that in the event of failure of the successful Bidder to furnish the required Performance Security, the entire said sum be paid immediately to the said Employer pursuant to IB.16 and IB.35 of the Instructions to Bidders for the successful Bidder's failure to perform.

NOW THEREFORE, if the successful Bidder shall, within the period specified therefor, on the prescribed form presented to him for signature enter into a formal Contract with the said Employer in accordance with his Bid as accepted and furnish within twenty eight (28) 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 Employer for the faithful performance and proper fulfilment 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.

BS-2

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

PROVIDED ALSO THAT the Employer shall decide, 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 Employer 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.

		SURETY (Scheduled Bank)	
WITNESS:		Signature	
1.		Name	
.....		Title	
	Corporate Secretary (Seal)		Corporate Guarantor (Seal)
2.			
.....			
	Name, Title & Address		



FORM OF PERFORMANCE SECURITY

Guarantee No.....

Executed on

Expiry date

[Letter by the Guarantor to the Employer]

Name of Guarantor with address:

.....

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 Employer) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Employer, 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 fulfil 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 Employer, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfil 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 the date certified in Taking-Over Certificate issued in accordance with Clause – 10, Employer's Taking Over of Condition of Contract and half of it i.e. (five) 05% of Contract Price, shall remain valid till the time all requirements of Clause11, Defects After Taking Over, 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.

PS-2

We,..... (the Guarantor), waiving all objections and defense under the Contract, do hereby irrevocably and independently guarantee to pay to the Employer without delay upon the Employer's first written demand without cavil or arguments and without requiring the Employer to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Employer'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 Employer's designated Bank & Account Number.

PROVIDED ALSO THAT the Employer shall decide, 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 Employer 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
(Schedule Bank)

WITNESS:

1.
.....
Corporate Secretary (Seal)

Signature

Name

Title

Corporate Guarantor (Seal)

2.
.....
Name, Title & Address



LOA-1

Letter of Acceptance

[Letterhead paper of the Employer]

NAME OF CONTRACT:.....

CONTRACT NUMBER:.....

TO :

Date:

Your Reference:

Our Reference:

We thank you for your Bid dated for the execution and completion of the Works comprising the above-named Contract and remedying of defects therein, all in conformity with the terms and conditions contained in the Contract.

We have pleasure in accepting your Bid for the Accepted Contract Amount of:

.....
[currency and amount in figures]

.....
[currency and amount in words]

In consideration of you properly and truly performing the Contract, we agree to pay you the Accepted Contract Amount or such other sums to which you may become entitled under the terms of the Contract, at such times and as prescribed by the Contract.

We acknowledge that this Letter of Acceptance creates a binding Contract between us, and we undertake to fulfil all our obligations and duties in accordance with the terms of this Contract.

Signature:.....

Signed by:

For and on behalf of:.....

Date:.....

FORM OF CONTRACT AGREEMENT

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

WHEREAS the Employer is desirous that certain Works, viz., _____ should be executed by the Contractor and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

NOW this Agreement witnessed 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, in the order of priority, 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:
 - a) the Contract Agreement;
 - b) the Letter of Acceptance;
 - c) the Letter of Technical Bid & Letter of Price Bid;
 - d) the Particular Conditions Part A - Contract Data;
 - e) the Particular Conditions Part B - Special Provisions;
 - f) the General Conditions of Contract;
 - g) the Bill of Quantities - (Schedule B to Bid);
 - h) the Schedule of Adjustment Data - (Schedule A to Bid);
 - i) Completed Schedule of Bids (C to J);
 - j) the Specification Part A - Specific Provisions;
 - k) the Specification Part B - Technical Provisions;
 - l) the Drawings;
 - m) the JV / Consortium Undertaking (if the Contractor is a JV / Consortium);
 - n) EMP;
 - o) or any other documents.

The addenda/corrigenda, if any, (Excluding part relating to Instructions to Bidders along with **Bidding Data**) shall be deemed to have been incorporated at the appropriate places in the "Documents forming the Contract".

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.
4. The Employer 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 Contactor

Signature of Employer

(Seal)

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness

Witness

(Name, Title and Address)

(Name, Title and Address)



DAAB-1

DAAB AGREEMENT

Name and details of the Contract _____

This Agreement made the _____ day of _____ [month], _____ [year], between

Name and contact details of the Employer _____ (name)
 _____ (address)
 _____ (telephone)
 _____ (email / other contact details);

Name and contact details of the Contractor _____ (name)
 _____ (address)
 _____ (telephone)
 _____ (email / other contact details);

Name and contact details of the DAAB Member _____ (name)
 _____ (address)
 _____ (telephone)
 _____ (email / other contact details);

("DAAB Agreement")

Whereas:

- A. the Employer and the Contractor have entered (or intend to enter) into the Contract;
- B. under the Contract, the "DAAB" or "Dispute Avoidance/Adjudication Board" means the sole member or three members (as stated in the Contract Data of the Contract) so named in the Contract, or appointed under Sub-Clause 21.1 [Constitution of the DAAB] or Sub-Clause 21.2 [Failure to Appoint DAAB Members] of the Conditions of Contract;
- C. the Employer and the Contractor desire jointly to appoint the above-named DAAB Member to act on the DAAB as:
 - a. the sole member of the DAAB, and where this is the case, all references to the "Other Members" do not apply; or
 - b. one of three members / chairman [delete the one which is not applicable] of the DAAB and, where this is the case, the other two persons are:

DAAB-2

_____ (name)	_____ (name)
_____ (address)	_____ (address)
_____ (telephone)	_____ (telephone)
_____ (email/ other contact details)	_____ (email/ other contact details)

the “Other Members”; and

D. the DAAB Member accepts this appointment.

2. The Employer, Contractor and DAAB Member jointly agree as follows:

1. The conditions of this DAAB Agreement comprise:
 - (a) Clause 21 [*Disputes and Arbitration*] of the Conditions of Contract, and any other provisions of the Contract that are applicable to the DAAB’s Activities; and
 - (b) the “General Conditions of Dispute Avoidance/Adjudication Agreement”, which is appended to the General Conditions of the “Conditions of Contract for Construction” Second Edition 2017 published by FIDIC (“GCs”), as amended and/or added to by the following provisions.
2. [Details of amendments to the GCs, if any. For example:
In the procedural rules annexed to the GCs, Rule _ is deleted and replaced by: “ ... ”]
3. The DAAB Member shall be paid in accordance with Clause 9 of the GCs. The currency of payment shall be _____.

In respect of Sub-Clauses 9.1 and 9.2 of the GCs, the amounts of the DAAB Member’s monthly fee and daily fee shall be:

monthly fee _____ per month, and
daily fee of _____ per day
(or as otherwise set under Sub-Clause 9.3 of the GCs).
4. In consideration of the above fees, and other payments to be made to the DAAB Member in accordance with the GCs, the DAAB Member undertakes to act as DAAB Member in accordance with the terms of this DAAB Agreement.
5. The Employer and the Contractor shall be jointly and severally liable for the DAAB Member’s fees and other payments to be made to the DAAB Member in accordance with the GCs.
6. This DAAB Agreement shall be governed by the law of _____ (if not stated, the law that governs the Contract under Sub-Clause 1.4 of the Conditions of Contract).



DAAB-3

SIGNED by:_____	SIGNED by:_____	SIGNED by:_____
Print name:_____	Print name:_____	DAAB Member
Title:_____	Title:_____	Title:_____
for and on behalf of the Employer	for and on behalf of the Contractor	

in the presence of	in the presence of	in the presence of
Witness:_____	Witness:_____	Witness:_____
Name:_____	Name:_____	Name:_____
Address:_____	Address:_____	Address:_____
_____	_____	_____
Date:_____	Date:_____	Date:_____

MG-1

FORM OF MOBILIZATION ADVANCE GUARANTEE/ BOND

Guarantee No. _____ Date _____

WHEREAS _____ (hereinafter called the 'Employer')

has entered into a Contract for _____

(Particulars of Contract)

with _____ (hereinafter called the "Contractor").

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

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

AND WHEREAS, ...

(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Employer 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 fulfilment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Employer for payment not exceeding the aforementioned amount.

Notice in writing of any default, on the part of the Contractor, of which the Employer at his discretion of making decision, shall be given by the Employer 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 is earlier.

(Date)

The Guarantor's liability under this Guarantee shall not in any case exceed the sum of PKR(Pak Rupees.....). 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

MG-2

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
(Scheduled Bank)

WITNESS:

Signature _____

1. _____

Name _____

Title _____

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

2. _____

Name, Title & Address

IB-1

INDEMNITY BOND FOR SECURED ADVANCE AGAINST MATERIAL BROUGHT AT SITE

(ON RS. 300 NONJUDICIAL STAMP PAPER)

This Deed of Indemnity is issued by M/s. _____ in favour of M/s. _____ Whereas _____ has paid the Secured Advance against the cost of material through any Bank or like agency by any other method by virtue of the terms of the contract existing between the parties. The details of the material and their price for which secured advance is being sought for the period _____ till consumption of the material is as under :-

1. _____ at Rs. _____ per _____ = Rs. _____
2. _____ at Rs. _____ per _____ = Rs. _____
3. _____ at Rs. _____ per _____ = Rs. _____
4. _____ at Rs. _____ per _____ = Rs. _____

THEREFORE THIS DEED OF INDEMNITY WITNESSETH AS FOLLOWS:

I/We _____ of M/s. _____ do hereby indemnify M/s. _____ for all losses due to thefts, arson, pilferage, loss due to flood and inundation, shortage, deterioration and depreciation etc. through any act of Man or God or slump in the Market of any or all the materials financed or paid by the Employer on our request for financing payment against material. I/We _____ shall indemnify _____ against any or all claims, action damages arising out of or resulting to the said material.

I/We _____ further declare that we will faithfully abide by the above declaration and solemnly affirm that we will not remove, sell, pilferage any of the materials against which M/s. _____ has paid us such a secured advance and will not pledge the same with any Bank, Finance Corporation, Firm, Company, Individual or the like agency or create any change whereon in any from what so ever.

I/We _____ do hereby also declare that in the event of my/our infringement of the declaration made above _____ will be entitled to forfeit all such material and also proceed against me/us according to the relevant clause pertaining to breach of contract and further invoke the power of seek any remedies secured of _____ under the contract Agreement signed with us or otherwise available under law.

Place _____

Dated _____

Contractor _____



GENERAL CONDITIONS OF CONTRACT



CONDITIONS OF CONTRACT FOR WORKS OF CIVIL ENGINEERING CONSTRUCTION GENERAL CONDITIONS

FIDIC

2017 Red Book, Reprinted 2022 with amendments

(To be procured by the Contractor)

Copies of the FIDIC Conditions of Contract can be obtained from:

**World Trade Center II - Geneva Airport
P. O. Box 311
CH-1215 Geneva 15 Switzerland
Email: fidic@fidic.org, fidic.pub@fidic.org
Website: <https://fidic.org/bookshop>**



PARTICULAR CONDITIONS
PART A – CONTRACT DATA

Part A - Contract Data

Sub-Clause	Data to be Given	Data
1.1.27	Defects Notification Period (DNP):	<u>365</u> days
1.1.31	Employer's name and address:	Name: Ravi Urban Development Authority (RUDA) Address: Engineering Wing of RUDA, 5-C Muslim Town, Facing Canal, Near Punjab Group of Colleges, Lahore..
1.1.35	Engineer's name and address:	Name: _____ Address: _____
1.1.84	Time for Completion:	420 days for whole of the Works from the Commencement Date.
1.3(a)(ii)	agreed methods of electronic transmission:	Email & facsimile
1.3(d)	address of Employer for communications:	Engineering Wing of RUDA, 5-C Muslim Town, Facing Canal, Near Punjab Group of Colleges, Lahore.
	address of Engineer for communications:	
	address of Contractor for communications:	_____ [insert Contractor's address at the time of signing of the Contract]
1.4	Contract shall be governed by the law of:	Islamic Republic of Pakistan
	ruling language:	English
	language for communications:	English
1.6	Contract Agreement	Within 14 days from the date of furnishing of acceptable Performance Security.
1.8	number of additional paper copies of Contractor's Documents:	05 Nos.
2.1	after receiving the Letter of Acceptance, the Contractor shall be given right of access to all or part of the Site within:	No later than the Commencement Date, except for the following parts: <u>03</u> days after Commencement Date.
2.4	Employer's financial arrangements	Own Source

Sub-Clause	Data to be Given	Data
3.2 (e)(ii)	Engineer's Duties and Authority	Variation resulting in an increase of the Accepted Contract Amount in excess of one percent (1%) subject to accumulative Variations not exceeding five percent (5%) of the Accepted Contract Amount.
4.1	Contractor's General Obligation	Warranty Services
4.2	Performance Security (as percentage of the Accepted Contract Amount in Currencies) Percent: 10% Currency: PKR	Ten percent (10%) of the amount stated in the contract document.
4.2.1	List of Insurance Companies	Insurance companies rated by PACRA/VIS having rating AA(+) is acceptable only.
4.7.2	period for notification of errors in the items of reference	Twenty Eight (28) days
4.19	period of payment for temporary utilities	N/A
4.20	number of additional paper copies of progress reports	06 Nos.
5.1(a)	maximum allowable accumulated value of work subcontracted (as a percentage of the Accepted Contract Amount)	Thirty percent (30%)
5.1(b)	parts of the Works for which subcontracting is not permitted	N/A
6.5	Normal working hours on the Site	08 Hrs per Day.
8.1	Commencement of Works	<i>Within 07 days from the Engineer's Notice to Commence.</i>
8.3	number of additional paper copies of programmes	03 Number of copies.
8.8 & 14.15(b)	Delay Damages payable for each day of delay	0.05% of the Contract Price stated in the Letter of Acceptance for each day of delay in completion of the works.
8.8	maximum amount of Delay Damages	Ten percent (10%) of the Accepted Contract Amount stated in the Letter of Acceptance.
8.14	Applicability of Incentives for Early Completion	N/A.
12.3	Percentage profit	Twenty percent (20%)

Sub-Clause	Data to be Given	Data
13.4.(b)(ii)	percentage rate to be applied to Provisional Sums for overhead charges and profit	Twenty percent (20%)
14.2	Total Advance Payment	Total 10% of Contract Price stated in Letter of Acceptance to be paid in two instalments as per Sub Clause 14.2.2.
14.2.1	List of Insurance Companies	Companies having rating AA(+) rated by PACRA/VIS.
14.2.3	percentage deductions for the repayment of the Advance Payment	Deduction shall be made at the amortization rate of 10 % of the value of the Works executed of each IPC as provided in paragraph (i) of Sub-Clause GCC 14.3, starting from 2 nd IPC provided that the advance payment shall be completely repaid prior to the time when 90% of the Accepted Contract Amount less Provisional Sums has been certified for payment.
14.3	period of payment	28 Days
14.3(b)	number of additional paper copies of Statements	05 Nos.
14.3 (iii)	percentage of retention	Seven percent (7%)
14.3 (iii)	Limit of retention money (as a percentage of the Contract Price.	Five percent (5%)
14.5(b)(i)	Plant and Materials for payment when shipped	N/A
14.5(c)(i)	Plant and Materials for payment when delivered to the Site	N/A
14.6.2	minimum amount of Interim Payment Certificate (IPC)	4 Million
14.7(a)	period of payment of Advance Payment to the Contractor	28 days
14.7b(i)	period for the Engineer to make interim payments to the Contractor under Sub-Clause 14.6 [Interim Payment]	28 days.
14.7b(ii)	period for the Employer to make interim payments to the Contractor under Sub-Clause 14.13 (Final Payment)	28 days.
14.7(c)	period for the Employer to make final payment to the Contractor	56 days
14.8	financing charges for delayed payment	N/A
14.11.1(b)	number of additional paper copies of draft Final Statements	05

Sub-Clause	Data to be Given	Data
14.15	currencies of payment of Contract Price	<i>Pak Rupees</i>
14.15(a)(i)	Proportions or amounts of Local and Foreign currencies	N/A
14.15(c)	currencies and proportions for payment of Delay Damages	Pak Rupees
14.15(f)	rates of exchange	N/A
17.2(d)	forces of nature, the risks of which are allocated to the Contractor	Nil
19.1	permitted deductible limits: i) insurance required for the Works ii) insurance required for Goods iii) insurance required for liability for breach of professional duty iv) insurance required against liability for fitness for purpose (if any is required) v) insurance required for injury to persons and damage to property vi) insurance required for injury to employees other insurances required by Laws and by local practice	i) Five percent (5%) of loss amount on each & every loss ii) Nil iii) Nil iv) Nil v) Nil vi) Nil Nil
19.1	Periods for submission of insurance: a. evidence of insurance b. relevant policies	Not later than the Commencement Date Within twenty-eight (28) day from the Commencement Date
19.2.1(b)	additional amount to be insured (as a percentage of the replacement value)	15% of the replacement value(Accepted Contract Amount)
19.2.2	extent of insurance required for Goods amount of insurance required for Goods	from Ex-Works (i.e., works, factory, warehouse, etc) to delivery at the Site Full replacement value
19.2.3(a)	amount of insurance required for liability for breach of professional duty	Full replacement value of the Works to be designed by the Contractor
19.2.3(b)	insurance required against liability for fitness for purpose	Yes
19.2.3	period of insurance required for liability for breach of professional duty	Until the date of issuance of Performance Certificate
19.2.4	amount of insurance required for injury to persons and damage to property	Injury to person and Fatal case:in accordance with

Sub-Clause	Data to be Given	Data
		Workmen Compensation Act Damage to Property: <u>as per Third Party Assessment and the number of incident is unlimited.</u>
19.2.6	other insurances required by Laws and by local practice	All insurances as applicable, to the extent of execution of the project, under Federal and Provincial laws of Islamic Republic of Pakistan.
21.1	time for appointment of the DAAB	Within 28 days from the Commencement Date. In case the Accepted Contract Amount is lesser than PKR one (01) billion appointment of the DAAB shall be made when Dispute arises between the Parties.
21.1	the DAAB shall comprise	_____ "Three Members"
21.1	List of proposed members of DAAB - proposed by Employer proposed by Contractor	[to be inserted at the time of signing of the Contract] 1. _____ 2. _____ 3. _____ 1. _____ 2. _____ 3. _____
21.2	Appointing entity (official) for DAAB members	CEO Ravi Urban Development Authority from the list of PEC approved arbitrators published at its website
21.6	Rules of Arbitration	PEC Rules of Conciliation and Arbitration or Pakistan Arbitration Act of 1940, if the former is inactive. The place of Arbitration shall be in the Employer's country: Pakistan



PARTICULAR CONDITIONS PART B – SPECIAL PROVISIONS

PART B - SPECIAL PROVISIONS

1.1	DEFINITIONS	1
1.2	INTERPRETATION	1
1.5	PRIORITY OF DOCUMENTS	1
1.6	CONTRACT AGREEMENT	2
3.1	THE ENGINEER	2
3.2	ENGINEER'S DUTIES AND AUTHORITY	2
4.1	CONTRACTOR'S GENERAL OBLIGATIONS	3
4.2	PERFORMANCE SECURITY	4
4.3	CONTRACTOR'S REPRESENTATIVE	4
4.4	CONTRACTORS DOCUMENTS	5
4.8	HEALTH AND SAFETY OBLIGATIONS	5
4.20	PROGRESS REPORT	7
5.1	SUBCONTRACTORS	8
5.2	NOMINATED SUBCONTRACTORS	9
6.1	ENGAGEMENT OF STAFF AND LABOUR	9
6.7	HEALTH AND SAFETY OF PERSONNEL	9
6.8	CONTRACTOR'S SUPERINTENDENCE	10
6.12	KEY PERSONNEL	10
6.13	FOREIGN PERSONNEL	10
6.14	SUPPLY OF FOOD STUFFS	10
6.15	SUPPLY OF WATER	10
6.16	MEASURES AGAINST INSECT AND PEST NUISANCE	11
6.17	ALCOHOLIC LIQUOR OR DRUGS	11
6.18	ARMS AND AMMUNITION	11
6.19	FESTIVALS AND RELIGIOUS CUSTOMS	11
6.20	FUNERAL ARRANGEMENTS	11
6.21	FORCED LABOUR	11
6.22	CHILD LABOUR	11
6.23	EMPLOYMENT RECORDS OF WORKERS	11
6.24	WORKER'S ORGANIZATION	12
6.25	NON-DISCRIMINATION AND EQUAL OPPORTUNITY	12
6.26	EPIDEMICS	12
7.7	OWNERSHIP OF PLANT AND MATERIALS	12
7.9	USE OF PAKISTANI MATERIALS AND SERVICES	13
8.1	COMMENCEMENT OF WORKS	13
8.3	PROGRAMME	14

8.5	EXTENSION OF TIME FOR COMPLETION	14
12.2	METHOD OR MEASUREMENT	14
12.3	VALUATION OF THE WORKS	14
13.4	PROVISIONAL SUMS	15
13.6	ADJUSTMENTS FOR CHANGES IN LAWS	15
14.2	ADVANCE PAYMENT	16
14.6	ISSUE OF IPC	17
14.7	PAYMENT	17
14.8	DELAYED PAYMENT	17
15.2	TERMINATION FOR CONTRACTOR'S DEFAULT	17
15.4	PAYMENT AFTER TERMINATION	18
16.2	TERMINATION BY CONTRACTOR	18
17.7	USE OF EMPLOYER'S ACCOMMODATION / FACILITIES	18
18.1	EXCEPTIONAL EVENTS	18
18.4	CONSEQUENCE OF AN EXCEPTIONAL EVENT	18
18.5	OPTIONAL TERMINATION	19
19.1	GENERAL REQUIREMENTS	19
19.2	INSURANCE TO BE PROVIDED BY THE CONTRACTOR	19
21.6	ARBITRATION	19
23	TAXES	19
24	INTEGRITY PACT	20

PART B - SPECIAL PROVISIONS

1.1 Definitions

- 1.1.31 The Employer is, Ravi Urban Development Authority (RUDA), Engineering Wing of RUDA, 5-C Muslim Town, Facing Canal, Near Punjab Group of Colleges, Lahore., represented by:

Chief Executive Officer, RUDA

151-Abu Bakar Block, Garden Town, Lahore

- 1.1.35 The Engineer is a competent person appointed by the Managing Director, NESPAK to act as the Engineer on behalf of National Engineering Services Pakistan (Pvt.) Limited, NESPAK House, 1-C, Block N – Model town Extension, Lahore or any other person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineer is to formulate his clarifications / recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

- 1.1.76 “Specifications”

Following is added at the end: “and consists of two parts i.e.,

- (i) “Part A – Specific Provisions”; and
- (ii) “Part B – Technical Provisions”.

1.2 Interpretation

“and” is deleted from the end of sub-paragraph (i) and added at the end of sub-paragraph (j).

Sub-paragraph (k) is added:

“(k) The word “tender” is synonymous with “bid” the word tenderer with “bidder”, the words “tender documents” with “bidding documents” and “Schedule of Prices” with “Bill of Quantities”, as applicable.”

1.5 Priority of Documents

The documents listed at (a) through (k) of this Sub-Clause are deleted and substituted with the following:

- a) the Contract Agreement;
- b) the Letter of Acceptance;
- c) the Letter of Technical Bid & Letter of Price Bid;
- d) the Particular Conditions Part A - Contract Data;
- e) the Particular Conditions Part B - Special Provisions;

- f) the General Conditions of Contract;
- g) the Bill of Quantities - (Schedule B to Bid);
- h) the Schedule of Adjustment Data – (Schedule A to Bid);
- i) Completed Schedule of Bids (C to J);
- j) the Specification Part A - Specific Provisions;
- k) the Specification Part B - Technical Provisions;
- l) the Drawings;
- m) the JV / Consortium Undertaking (if the Contractor is a JV / Consortium);
- n) EMP;
- o) or any other documents.

The addenda/corrigenda, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

1.6 Contract Agreement

In the first line of the first paragraph, the text “35 days” is replaced with “14 days”

In the last line of the 1st paragraph the text “shall be borne by the Employer” is substituted by “shall be borne by the Contractor”.

3.1 The Engineer

In sub-paragraph (a) the text “as defined in the Pakistan Engineering Council Act, 1975 (Act No. V of 1976)” are added after the words “professional engineer”.

3.2 Engineer's Duties and Authority

The Engineer shall obtain the consent in writing of the Employer before taking action under the following Sub-Clauses of these Conditions:

- (a) Consenting to the subcontracting of any part of the Works under Sub-Clause 5.1 (Subcontractors);
- (b) Any action under Sub-Clauses 8.9 [Employer's Suspension] and 8.12 [Prolonged Suspension];
- (c) Issuance of “Taking Over Certificate” under Sub-Clause 10.1 [Taking Over the Works and Sections];
- (d) Issuing the “Performance Certificate” under Sub-Clause 11.9 [Performance Certificate];
- (e) Sub-Clause 13.1 [Right to Vary]: instructing a Variation, except;
 - (i) in an emergency situation as determined by the Engineer, or
 - (ii) if such a Variation would increase the Accepted Contract Amount

by less than the percentage specified in the Contract Data.

- (f) Sub-Clause 13.3 [Variation Procedure]: approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.3.2 [Variation by Request for Proposal] or 13.2 [Value Engineering];
- (g) Certifying release of second half of the Retention Money under Sub-Clause 14.9 [Release of Retention Money];
- (h) Issuing Final Payment Certificate under Sub-Clause 14.13 [Issue of FPC].

Engineer under Sub-Clause 3.7 [Agreement or Determination], as stated in Sub-Clause 3.2 [Engineer's Duties and Authority] of the General Conditions.

Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility 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, despite the absence of approval of the Employer, 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 13 and shall notify the Contractor accordingly, with a copy to the Employer.

Following is added after the words "the Employer's consent is required" in 4th paragraph:

"stating that the Employer's consent has been obtained for that specified authority"

4.1 Contractor's General Obligations

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

"The Contractor shall provide warranty for all equipment for a period of one (01) year except Computing whose warranty shall be of three years (03) through authorized local distributor commencing from the date of the TOC to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services. The Bidder shall provide warranty of all Equipment.

4.2 Performance Security

4.2.1 “Contractor’s Obligation”

The first paragraph of this sub-clause is deleted and replaced with the following text:

The Contractor shall provide Performance Security to the Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 7 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance.

In case of Joint Venture, the Performance Security shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.

Such Security shall be in the form of:

- i. Ten (10) percent of the Contract Amount in the form of (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; and

Performance Security for the full amount of 10% shall remain valid till the date certified in the Taking Over Certificate (TOC) and half of it i.e., 5% provided in the form of bank guarantee shall be released upon issuance of TOC. Thereafter, the Performance Security for the amount of 5% arranged bank guarantee shall remain valid till the issuance of Performance Certificate.

The cost of complying with requirements of this Sub-Clause shall be borne by the Contractor.

4.3 Contractor’s Representative

In second paragraph the text “professional engineer as defined in the Pakistan Engineering Council Act, 1975 (Act No. V of 1976) (having temporary licence in case of foreign engineer under Section 12 of the Pakistan Engineering Council Act, 1975 (Act No. V of 1976)” are added after the words “qualified, experienced”.

In the 3rd paragraph the words “28 days” are substituted by “14 days”. In 2nd line of 4th paragraph the text “or appoint a replacement” is substituted by “except appointment of a suitable temporary replacement is deployed at the Site”

4.4 Contractors Documents.

“4.4.2 As-Build Record”

First paragraph is deleted and the text in the last paragraph is substituted with the following:

“The Contractor shall furnish to the Engineer 6 copies, one reproducible and one electronic copy (provided the Engineer has made available to the Contractor editable form of the Drawings) of all Drawings amended to conform to the Works as built. In case the Engineer does not make available to the Contractor editable form of the Drawings, the Contractor shall furnish to the Engineer as-built data for incorporation in the Drawings. Upon receipt of PDF versions of the as-built drawings prepared by the Engineer, the Contractor shall furnish to the Engineer 6 copies and one reproducible of these Drawings.

The price of such Drawings shall be deemed to be included in the Contract Price.”

Following Sub-Clause is added:

4.4.4 “Shop Drawings”

The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of relevant Sub-Clause of the Contract.

Review and approval by the Engineer shall not exceed 21 days and be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory and the Engineer’s review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

4.8 Health and Safety Obligations

The following text is added at the end of this Sub-Clause:

In the event of work being carried out outside the normal working hours and 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.

The Contractor shall:

- Prevent all road accidents that might arise as a consequence of its activities;
- Adhere to the following principles of Environmental Management Guidelines;

- Minimize gaseous emissions, liquid effluents and discharge of solid waste that is known to have a negative impact on the environment;
- Within fourteen (14) days of the commencement date the Contractor shall submit his (Project Health and Safety Plan) to the Engineer review, He should nominate the key person in his organization who will be responsible for administrating the plan;
- In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes 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 authorise 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;
- All employees shall be physically qualified for performing the duties to which they are assigned, Operators of equipment and vehicles shall be qualified (licensed) they shall be able to read and understand the signs, signals and operating instructions in use;
- Contractor shall protect all people involved with or potentially affected by its operation from the adverse consequences of fire or explosions and shall safeguard all Engineer's assets to a level commensurate with their critically;
- Contractor must also provide adequate protective clothing and equipment PPE's to prevent, so far reasonably practicable risk of accidents or adverse effect on safety and health;
- Contractor is required to ensure that, so far as is reasonably practicable, the workplace, machinery, equipment and process under control are safe and without a risk to health;
- Prior to start of work, Contractor must provide measures to deal with emergencies and accidents, including adequate first aid arrangements, in the ratio of one (01) unit each twenty-five(25) persons or less, also and emergency vehicle, doctor and equipped clinic in case of exceeding 500 workers or providing private personnel health card for each worker at close clinic to the project as per prevailing Pakistan Labour Law;
- Contractor shall recognize the responsibility to protect the environment in order that the future well-being of society is safeguarded and make every effort to minimize the impact of its operations on the environment and people;
- Contractor's liability insurance should satisfy requirements to carry appropriate insurance so that a worker who is harmed is assured of receiving compensation. Other cost that be incurred relate to:
 - Damage to properties, goods and equipment
 - Accident investigations
 - Possible fines and associated legal fees

- Qualified and experienced safety officers and the number of officers and safety staff that comply to international safety practices as applicable, one officer for each 150 workers shall be deployed at the site;
- The Contractor and his supervisors/foremen are responsible for administration of comprehensive Project HSE plan. The Project HSE Plan shall embody prevention of accidental injury, occupational illness and property damage. The Contractor shall provide and maintain a safe hazard free workplace for their employees, for fellow workers and general public. The project HSE plan shall ensure the involvement and active participation of all project employees by requiring safety training, which shall promote recognition of unsafe acts, unsafe conditions and potential and actual hazards, and the immediate corrective action to be taken. All the employees shall be constantly aware of their responsibilities to work in a safe manner;
- The Contractor shall identify the hazards involved in the Project during the Contract execution and shall implement the necessary controls to eliminate or mitigate these hazards.
- Expeditious response in case of injury, fire, security and natural disaster etc. to be ensured;
- Water sprinkling within the Project boundary to be ensured on as required basis;
- Adequate number of manpower to be deployed depending upon the weight and extent of the material/equipment to be lifted;
- Fall protection above 1.8 m (6 ft.) to be provided with guard / handrails, full body harness and safety nets;
- Guard rails and toe boards above 20 m (65 ft.) required to cordon off the Project site to be provided;
- Scaffolding and ladder not to be used without approval from safety staff;
- Angle of repose to be calculated and implemented where the depth of excavation exceeds 1.2 m;
- Drilling bore holes and pits to be covered and barricaded;
- Noise exceeding 85 dBA to be avoided for daily exposure and 140 dBA for peak exposure, Ear plugs and earmuffs to be ensured for peak exposure;
- 3-wire type extension cords to be used for electrical works and worn electrical cables to be discarded;
- Waste disposal at Government approved locations to be done on daily basis.

Notwithstanding the provisions contained under this Sub-Clause, any additional cost with regard to HSE as incurred by the Contractor with the consent of the Engineer duly approved by the Employer, shall be payable to the Contractor.

4.20 Progress Report

At the start of sub-paragraph (a) add "Executive summary, Contract Startup

Activities, salient contractual and project information,”

At the end of sub-paragraph (g) the word “and” is deleted and at the end of sub-paragraph (h) the full stop (.) is replaced with “;”, and the following new sub-paragraphs are added as:

- (i) planned programme for the execution of the Works for next 56 days to enable the Engineer to determine its programme of inspection and testing;
- (j) monthly summery of daily job record indicating weather conditions, deployment of Contractor’s Equipment, labour employment, local material procurement and material import, if any;
- (k) Risk Management;
- (l) Performance Security / Guarantees & Insurances Details;
- (m) Change Management;
- (n) Financial Management;
- (o) Completion of Works and Contract Closure;
- (p) Drone Video Progress Documentary; and
- (q) Time Lapse & Real Time Web Based Progress Centre.

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.

1. Drone Video Progress Documentary:

The Contractor shall document the entire project development from various position and capture a complete video documentary on monthly basis with high resolution drone cameras. Properly comprehensive progress video as required by The Engineer/Employer.

Drone video Progress Documentary must be submitted on Monthly Basis as per satisfaction of The Engineer/Employer along with Monthly Progress Report on 8th Day of Each Month.

2. Time Lapse & Realtime Web Based Progress Centre

The Contractor shall document the entire project development and project assets from various static angles by placing several Time Lapse high resolutions cameras and setup an un-interrupted web-based progress centre.

5.1 Subcontractors

Add the following text at the end of paragraph (ii):

“under Schedule to Bid”

The following is added at the end of the last paragraph of Sub- Clause 5.1:

“All subcontracts relating to the Works shall include provisions which entitle the Employer to require the subcontract to be assigned to the Employer under sub-paragraph (a) of Sub- Clause 15.2.3 [After Termination].

The Contractor shall give reasonable opportunity to contractors from Islamic Republic of Pakistan for subcontracts for the Works, and endeavour to employ such contractors as Subcontractors.”

5.2 Nominated Subcontractors

5.2.2 Objection to Nomination

In sub-paragraph (c), “and” is deleted from the end of (i); “.” at the end of (ii) is replaced with: “, and”.

The following is then added as (iii):

“(iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.2.3 [Payment to nominated Subcontractors].”

6.1 Engagement of Staff and Labour

The following paragraph is added at the end of the Sub-Clause:

“The Contractor shall, to the extent practicable and reasonable, employ staff (not less than 50%) and labour (not less than 85%) with appropriate qualifications and experience from sources within the Islamic Republic of Pakistan.”

6.7 Health and Safety of Personnel

The existing text is substituted with the following:

“In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes 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 also provide all other medical services and appoint a health and safety officer at Site if stated in the Specifications. In case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means.”

6.8 Contractor's superintendence

Insert at the end of sub-paragraph (a) of this Sub-Clause:

"or, if not, the Contractor shall make competent interpreters available during all working hours, in a number sufficient for those persons to properly perform their superintendence duties"

The following text is added at the end of this Sub-Clause:

"The Contractor's authorized representative and his other engineers working at site shall possess valid registration 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 the Contract."

6.12 Key Personnel

The following is inserted at the end of the last paragraph:

"If any of the Key Personnel are not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."

The following Sub-Clauses 6.13 to 6.26 are added at the end of Sub-Clause 6.12:

6.13 Foreign Personnel

The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use all reasonable endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.

6.14 Supply of Food stuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.15 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's

Personnel.

6.16 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

6.17 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereto by Contractor's Personnel.

6.18 Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.19 Festivals and Religious Customs

The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.20 Funeral Arrangements

The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of its local employees who may die while engaged upon the Works.

6.21 Forced Labour

The Contractor, including its Subcontractors, shall not employ or engage forced labour which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.

6.22 Child Labour

The Contractor, including its Subcontractors, shall not employ or engage child labour in accordance with relevant law(s) in force in Islamic Republic of Pakistan.

6.23 Employment Records of Workers

The Contractor shall keep complete and accurate records of the employment

of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 (*Contractor's Records*).

6.24 Worker's Organization

The Contractor shall comply with the relevant labour laws of Pakistan which recognize workers' rights to form and to join workers' organizations/Trade Union of their choosing and to bargain collectively without interference.

6.25 Non-Discrimination and Equal Opportunity

The Contractor shall not make decisions relating to the employment or treatment of Contractor's Personnel on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment of Contractor's Personnel on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices.

Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination. The Contractor shall provide protection and assistance as necessary to ensure nondiscrimination and equal opportunity, including for specific groups such as women, persons with disabilities, migrant workers and children (of working age in accordance with Sub-Clause 6.22).

6.26 Epidemics

In the event of any out-break of illness of 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 the purpose of overcoming the same.

7.7 Ownership of Plant and Materials

The following is added before the first paragraph:

"Except as otherwise provided in the Contract,"

The following is added at the end of the Sub-Clause:

"No Plant and/or Materials that is the property of the Employer shall be removed from the Site. Contractor shall be responsible for transportation of equipment / plant at site. It will be the responsibility of contractor to ensure the

safety of delivered equipment / plant at site. Employer will in no case be held liable for any damage or loss of equipment delivered or erected at site. Moreover, contractor will not be allowed to relocate or install the delivered equipment / plant without the permission of Employer. If it becomes necessary to:

- (i) remove any item of such Plant from the Site for the purposes of repair, the Contractor shall give a Notice, with reasons, to the Engineer requesting consent to remove the defective or damaged item off the Site. This Notice shall clearly identify the item of defective or damaged Plant, and shall give details of: the defect or damage to be repaired; the place to which defective or damaged item of Plant is to be taken for repair; the transportation to be used (and insurance cover for such transportation); the proposed inspections and testing off the Site; and the planned duration required before the repaired item of Plant shall be returned to the Site. The Contractor shall also provide any further details that the Employer may reasonably require; or
- (ii) replace any item(s) of such Plant and/or Materials, the Contractor shall give a Notice, with reasons, to the Engineer clearly identifying the item(s) of Plant and/or Materials to be replaced, and giving details of the due date of delivery to the Site of the replacement item(s).

Where any item of Plant and/or Materials has become the property of the Employer under this Sub-Clause before it has been delivered to the Site, the Contractor shall ensure that such an item is not moved except for its delivery to the Site.

The Contractor shall indemnify and hold the Employer harmless against and from the consequences of any defect in title or encumbrance or charge (except any reasonable restriction arising from the intellectual property rights of the manufacturer or producer) on any item of Plant and/or Materials that has become the property of the Employer under this Sub-Clause."

The following Sub-Clause 7.9 is added after Sub Clause 7.8:

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

The following is added before the first paragraph:

"After signing of the Contract Agreement by both Parties," and thereafter the word "The" is replaced with the word "the".

The words "14 days" in the second line of the first paragraph are deleted and replaced with the words "7 days".

8.3 Programme

The following text is added after the first paragraph:

The initial programme and each revised programme shall be:

- 1) Developed and presented on Project Management Software Primavera Project Planner P6 or later.
- 2) Developed on the basis of Work Breakdown Structure provided or approved by The Engineer/Employer.
- 3) Detailed up to level 4 or as required by The Engineer/Employer.
- 4) Appropriate quantity of direct resources (material, labour, equipment) should be allocated to all activities and showed in submitted construction schedule. Labour resource should be divided according to related trades (e.g. Mason, Operator, helper etc.) Contractor should make sure that no resource is being overallocated.
- 5) BOQ amount should be loaded to each construction activity. Earned Value Management Reporting to be ensured accordingly.
- 6) Identifying the critical path activities, showing all works including temporary works, the relation between early and late starting dates for each activity until completion, which will be the same as the specified Project end date.

8.5 Extension of Time for Completion

The following is added after the first paragraph (c):
“for last five years”

12.2 Method or Measurement

The following paragraph is added at the end of the Sub-Clause:

“Summary of measured quantity for payment shall be delineated item-wise under four heads namely; “Schedule of Prices Quantity”, “Quantity Executed To-date”, “Quantity Certified Previously” and “Net Quantity Executed under this Certificate”.

12.3 Valuation of the Works

In sub-paragraph (b)(i) the text “10%” is deleted and replaced with the text “25%”.

The text of the sub-paragraphs (b)(ii) and (b)(iii) are deleted.

The sub-paragraph (b)(iv) shall be read as sub-paragraph (b)(ii).

The following text is added at the end of sub-paragraph (b):

“If, on the issue of the Taking-Over Certificate for the whole of the Works, it is found that as a result of:

- (a) all varied work valued under this Sub-Clause and Sub-Clauses 13.1, 13.2,

and 13.3,

- (b) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding Provisional Sums, dayworks and adjustments of price made under Clause 13.7,
- (c) but not from any other cause, there have been additions to or deductions from the Contract Price which 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 dayworks, 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 the Engineer 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 the Employer. Such sum shall be based only on the amount by which such additions or deductions shall be in excess of 15 per cent of the Effective Contract Price.

The text of the fifth paragraph is deleted and replaced with the following:

"Each new rate or price shall be derived from any relevant rates or prices specified in the Bill of Quantities. If altered, additional or substituted work includes any item of work, for which no rate is specified in the Bill of Quantities (BOQ) of this Contract, then the rate of that particular item shall be taken or derived from the Market Rates System (MRS) (input rates), Government of the Punjab at the time of Bidding. If the rate of such item is either not available in MRS or not derivable from MRS input rates, then that rate shall be probed by the Engineer on the basis of market rates, together with the applicable percentage of overhead charges and profit of twenty percent (20%).

13.4 Provisional Sums

The following paragraph is inserted as the penultimate paragraph:

"The Provisional Sum shall be used to cover the Employer's share of the DAAB members' fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB. The Contractor shall submit the DAAB members' invoices and the satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those Statements submitted under Sub-Clause 14.3.

13.6 Adjustments for Changes in Laws

The following paragraphs are added at the end of the Sub- Clause:

"Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in

the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the Table of Adjustment Data in accordance with the provisions of Sub-Clause 13.7 (*Adjustments for Changes in Cost*)."

14.2 Advance Payment

14.2.1 Advance Payment Guarantee

The entity issuing the Advance Payment Guarantee and its form shall be as under:

The Advance Payment Guarantee shall be in the form of Guarantee issued by (a) a Scheduled Bank in Pakistan or (b) a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan for the amount of the Total Advance Payment in accordance with Sub-Clause 14.2.

In case of Joint Venture, the Advance Payment Guarantee(s) shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.

14.2.2 Advance Payment Certificate

The text of the first paragraph of the Sub-Clause is deleted and replaced with the following text:

"The Employer shall sanction an interest free Advance Payment equal to ten percent (10%) of the Contract Price stated in the Letter of Acceptance. Initially, the Engineer shall issue an Advance Payment Certificate equal to five percent (05%) for the advance payment within 28 days after:

The text of sub-paragraph (a) is deleted and replaced with the following text:

- i. submission of the Performance Security, in the form and issued by an entity in accordance with Sub-Clause 4.2.1 [*Contractor's Obligations*];
- ii. signing of the Contract Agreement between the Parties in accordance with Sub-Clause 1.6 [*Contract Agreement*];
- iii. the Advance Payment Guarantee for the Total Amount of the Advance Payment, in the form and issued by an entity in accordance with Sub-Clause 14.2.1 [*Advance Payment Guarantee*];
- iv. submission of initial programme under Sub-Clause 8.3 [*Programme*];"

The word "and" at the end of the sub-paragraph (a) is deleted.

The character "." at the end of sub-paragraph (b) is deleted and replaced with the character ";

Following sub-paragraphs (c) & (d) are added after sub-paragraph (b):

- (c) A further sum equal to five percent (05%) of the Contract Price shall be paid

to the Contractor upon the certification of the Engineer to the effect that Contractor's mobilization is complete in the following aspects and he is ready to commence the works:

- i. Approval of initial programme under Sub-Clause 8.3 *[Programme]*;
- ii. Provision of machinery and equipment at the Site, as instructed by the Engineer.
- iii. Submission of a statement indicating status / plan / commitment for mobilization / hiring / purchase of remaining machinery.
- iv. Completion of facilities to be provided to the Engineer or the Engineer's Representative as per Contract Document.
- v. Submission of all guarantees as required by the Contract.
- vi. Establishment of Employer's, Engineer's and Contractor's site office.
- vii. Deployment of Contractor's technical as well as managerial staff as per requirement of site.
- viii. Proper taking over of the site.
- ix. Installation of project boards at all ends.
- x. Completion of safety arrangements for the traffic and public in general.
- xi. The Advance Payment shall not be subject to retention; and

(d) the Engineer has received a copy of the Contractor's application for the second tranche of advance payment under Sub-Clause 14.2.1 *[Advance Payment Guarantee]*.

14.6 Issue of IPC

14.6.1 The IPC

In the first line of the 1st paragraph the words "28 days" are substituted by "14 days"

14.7 Payment

The words "or through crossed cheque in favour of the Contractor or JV partners. The Payment to JV partners shall be made at the request of the Joint Ventures in the ratio of their shares specified by them" are added at the end of the Sub-Clause.

14.8 Delayed Payment

The text of this Sub-Clause is deleted in its entirety.

15.2 Termination for Contractor's Default

"15.2.1 Notice"

Following text is added at the end of sub-paragraph (h) of this Sub-Clause:

"For the purposes of this Contract, corrupt and fraudulent practices have

been defined in accordance with RUDA Procurement Regulations.”

15.4 Payment after Termination

The following text is added at the end of this Sub-Clause:

“The Employer shall be entitled to sell any of the Contractor’s Equipment, Temporary Works and unused materials and apply the proceeds of sale towards payment of any debt due from the Contractor to the Employer under this Clause including any outstanding payments to the Subcontractors.

16.2 Termination by Contractor

16.2.1 Notice

The sub-paragraph (j) is deleted in its entirety.

At the end of sub-paragraph (i) “; or” is replaced with “.” and at the end of sub-paragraph (h) “;” is replaced with “; or”.

In sub-paragraph (f) “84 days” are replaced with “180 days” and text “for reasons not attributable to the Contractor” is added at the end.

17.1 Responsibility for Care for the Works

After the two instances of “Goods” in the last paragraph, the words “Employer-Supplied Materials and/or Employer’s Equipment” are added.

The following Sub-Clause 17.7 is added after Sub-Clause 17.6:

17.7 Use of Employer’s Accommodation / Facilities

The Contractor shall take full responsibility for the care of the items of the Employer’s facilities and/or accommodation, if any, as detailed in the Specification, from the date of use and/or occupation by the Contractor until the date on which such use and/or occupation is re-vested in the Employer.

If any loss or damage happens to any of the above items during a time while the Contractor is responsible for its care, arising from any cause other than a cause for which the Employer is responsible or liable, the Contractor shall promptly rectify the loss or damage at the Contractor’s risk and cost.

18.1 Exceptional Events

The words “or disorder” are replaced with “disorder or sabotage” in sub-paragraph (c) of the Clause.

18.4 Consequence of an Exceptional Event

The following is added at the end of sub-paragraph (b) after deleting the “.”:

“,including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Exceptional Events, to the extent they are not

indemnified through the insurance policy referred to in Sub-Clause 19.2 (*Insurance to be provided by the Contractor*)."

18.5 Optional Termination

In sub-paragraph (c), the words "and necessarily" are added after the words "was reasonably".

19.1 General Requirements

Following text is added at the end of first paragraph:

"The Contractor shall immediately after the date of the Letter of Acceptance submit the draft of insurance policies for the Employer's consent."

Following text is added at the end of third paragraph:

"The Contractor shall, within the respective periods stated in the Contract Data submit to the Engineer and the Employer a) evidence that the insurances described in this Clause have been effected, and b) copies of policies of the insurances described in Sub-Clauses 19.2.1, 19.2.4 and 19.2.5."

19.2 Insurance to be Provided by the Contractor

19.2.5 Injury to employees

The words "sickness, disease" are deleted in the third line of first paragraph.

The following Sub-Clause is added after Sub-Clause 19.2.6:

19.2.7 Insurance Company

"The Contractor shall be obliged to place all insurances described in this Clause with insurers listed in the Contract Data and rated by PACRA/VIS of AA(+) rating.

21.6 Arbitration

The word "international" is deleted in the sixth line of first paragraph. The text of sub-paragraph (a) is substituted with the following:

"the Dispute shall be finally settled under the Rules of Arbitration, specified in the Contract Data;"

The following Clauses are added after Clause 21:

23 Taxes

The Contractor, Subcontractors and their employees shall be liable to pay income tax, withholding tax, super tax and other taxes on income arising out of the Contract. The rates and prices as stated in the contract shall be deemed to cover

all such taxes.

24 Integrity Pact

If it is found and established at any stage that the Contractor or any of his Subcontractors, agents or servants have violated or involved in violation of the Integrity Pact signed by the Contractor 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, agent 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, agent or servants.

The termination under sub-paragraph (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clause 15.1 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- paragraph (a) and (c) of this Sub-Clause.



RAVI URBAN DEVELOPMENT AUTHORITY
INFRASTRUCTURE DEVELOPMENT AT CHAHAR BAGH
MAIN SUMMARY



Sr. No	Item Description	Amount (Rs.)
	Electrical Works	
	TOTAL CONSTRUCTION COST	
	PST @ 16% of Construction Cost	
	TOTAL COST	





RAVI URBAN DEVELOPMENT AUTHORITY
INFRASTRUCTURE DEVELOPMENT AT CHAHAR BAGH (PHASE -I)
BILL OF QUANTITIES



Sr. No.	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
	The Electrical Works include supply, transportation, storage, earthing, installation, testing and commissioning of the following items of works as mentioned (unless specifically stated otherwise) including all material, labour, tools, accessories, related civil works, etc., as required for proper completion of each item as per specifications unless otherwise mentioned for proper completion of each item as per relevant specifications, drawings and/or as directed by the Consultant /Engineer according to WAPDA/LESCO standard/ specifications complete in all respect. (Any necessary material not mentioned in specifications, electrical drawings and here in this BOQ required for proper installation, testing and commissioning of equipment and materials shall be included in BOQ rates. Bid price shall be final. No Separate payment will be made for any such material. The Contractor shall be bond to provide any such material after award of this contract for proper completion of the Electrical Installation Works.) Contractor is also advised to inform missing items (if any) in BoQ at time submitting the tender.				
A-	MV & LV OUTDOOR ELECTRICAL EQUIPMENT				
1.0	11kV RING MAIN UNIT (RMU) & FOUNDATION				
	11kV Ring Main Unit (MV Switches) complete (Pad-mounted) as per WAPDA/LESCO Specifications No. DD-S-46:2009 amended to-date on the already prepared foundations, according to drawings provided by the manufacturer include cable termination boots etc., for proper completion of each item as per specifications unless otherwise mentioned for proper completion.				
1.1					
a)	4-Way Type (with Mechanical Interlocking)	No.	13.00		
b)	4-Way Type	No.	5.00		
c)	3-Way Type	No.	14.00		
	Construction of the foundation for following Pad Mounted MV switches, conforming to requirements, technical specifications, standards, Drawings etc. and to the approval of the Engineer with consultation of consultant according to WAPDA/LESCO standard. Contractor shall submit the detail foundation design.				
1.2					
a)	4-Way Type	No.	18.00		
b)	3-Way Type	No.	14.00		
2.0	11/0.415 kV Outdoor Distribution Transformer & Foundation				
	Pad-Mounted Outdoor type oil-immersed distribution transformers (11/0.415kV) with kiosk substation conforming to requirements as per WAPDA/LESCO specification No. DDS-71-2004 & 84-2007 amended to date: on the already prepared foundations, according to drawings provided by the manufacturer include cable termination boots etc., for proper completion of each item as per specifications unless otherwise mentioned for proper completion.				
2.1					
a)	630 kVA	No.	1.00		
b)	400 kVA	No.	1.00		
c)	200 kVA	No.	24.00		
d)	100 kVA	No.	15.00		
	Construction of the foundation for following Pad Mounted Distribution Transformers, conforming to requirements, technical specifications, standards, Drawings etc. according to drawings provided by the manufacturer and approved by the Engineer with consultation of consultant according to WAPDA/LESCO standard. Contractor shall submit the detailed foundation design.				
2.2					
a)	630 kVA	No.	1.00		
b)	400 kVA	No.	1.00		
c)	200 kVA	No.	24.00		
d)	100 kVA	No.	15.00		
3.0	LV Distribution Service Boxes & Foundation				
	Three Phase, 415 Volts, 50Hz (RYBN) Low Voltage Distribution Boxes (Service Box) as per WAPDA Specification No. DDS 89-2008 amended to date, comprising of aluminum busbar, terminal lugs suitable for multi-core LV power cables for providing of electric connections according to WAPDA/ LESCO specifications complete in all respect.				
3.1		No	195.00		
	Construction of the foundation for LV Distribution Service Boxes, conforming to requirements, standards, Drawings etc. and to the approval of the Engineer with consultation of consultant according to WAPDA /LESCO standard.				
3.2		No	195.00		
4.0	Earthing System (Rod-Type)				
	Earthing System complete for above referred items 1.1, 2.1 & 3.1 including ground conductor (10 mm standard G.I wire) Clamps, MS Galvanized earth rod 10"x5/8" and earth rod clamp etc. obtain the specified earth resistance, as per requirements, specification, and approval of the Engineer in-charge according to specifications.				
4.1					
a)	Galvanized Rod, clamp connections and accessories	Set	403.00		
b)	10mm dia GI wire (6kg per Earth)	KG	2,418.00		
SUB - TOTAL OF A					



RAVI URBAN DEVELOPMENT AUTHORITY
INFRASTRUCTURE DEVELOPMENT AT CHAHAR BAGH (PHASE -I)
BILL OF QUANTITIES



Sr. No.	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
B-	POWER CABLE SYSTEM (MV & LV)				
1.0	MV (8.7/15kV) Cables, Termination Kits, Straight Joint Kits & Earth Fault Indicator				
1.1	XLPE insulated aluminium stranded conductor armoured cables as per WAPDA Specifications No. P-29: 2010 amended to date, voltage grade: 8.7/15kV, laid directly in sand layer in already excavated trenches or through the RCC pipe (already laid at road crossings) 1 core cable to be laid in trefoil and binding with ties and feeder No. tagged on the cable every 5 meters as per specification & standards, provided in the given drawings and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	1-core 500mm ² (1000MCM) Al./XLPE/AWA/PVC cables)	Rm.	98,500.00		
b)	3-core 120mm ² (240MCM) Al./XLPE/SWA/PVC cables)	Rm.	7,250.00		
1.2	Termination kits for MV cables laid under item 1.1, for cables including Brass cable glands bimetallic lugs, miscellaneous material and allied connecting hardware complete in all respect and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	1-core 500mm ² (1000MCM) Al./XLPE/AWA/PVC cables)	No.	291.00		
b)	3-core 120mm ² (240MCM) Al./XLPE/SWA/PVC cables)	No.	90.00		
1.3	Straight Cable Joints for MV cables laid under item 1.1, as per specifications, drawings including allied connecting hardware complete in all respect and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	1-core 500mm ² (1000MCM) Al./XLPE/AWA/PVC cables)	No.	201.00		
b)	3-core 120mm ² (240MCM) Al./XLPE/SWA/PVC cables)	No.	30.00		
1.4	11kV Earth Fault Indicators including guard box for protection with base plate alongwith locking arrangement complete in all respect on 11kV cables as per instruction and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	110 mm (for 3 core 120 mmsq. Cable)	Each	48.00		
b)	150 mm (for 1 core 500 mmsq. Cable)	Each	60.00		
2.0	LV (600/1000V) Cables and Termination Kits				
2.1	Low Voltage (LV) Al./PVC/PVC cable as per WAPDA specifications No. DD-S-8:2007 amended to date, directly laid in already excavated trenches or through the RCC pipe (already installed at road crossings) as per specifications, standard provided in the drawings and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	4-core 300mm ² Al./PVC/PVC cables	Rm.	200.00		
b)	4-core 185mm ² Al./PVC/PVC cables	Rm.	10,850.00		
2.2	Termination kits for LV cables laid under item 2.1, for cables including Brass cable glands, Aluminum/Bi metallic lugs, miscellaneous material and allied connecting hardware complete in all respect or as requirements and according to WAPDA/LESCO standard/ specifications complete in all respect.				
a)	4-core 300mm ² Al./PVC/PVC cables	Each	2.00		
b)	4-core 185mm ² Al./PVC/PVC cables	No.	375.00		
3.0	Cable Markers for MV/LV Cables				
3.1	Cable Markers of appropriate size in concrete construction with engraved or embossed arrangement for routing and jointing of MV and LV cables as per site requirements or as directed by the Engineer.	Nos.	1,023.00		



RAVI URBAN DEVELOPMENT AUTHORITY
INFRASTRUCTURE DEVELOPMENT AT CHAHAR BAGH (PHASE -I)
BILL OF QUANTITIES



Sr. No.	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
4.0	CIVIL WORKS				
	Civil Works including Excavation, Backfilling & HDD/TB				
4.1	Excavation of every type of trenches in any type of soil within project premises for laying of MV & LV cables, as per dimensions given on the drawings.	Cum.	30,680.00		
4.2	Back filling of any type of trench already excavated, after laying various cables (MV/LV) including sand bed, protective brick works, warning tape and compaction of excavated earth compaction in layers at 90% of MDD as per modified AASHTO, site cleaning etc., as per drawing and to the approval of the Engineer according to standard.				
a)	Sand (Bed and Cover) - (A3)	Cum.	14,317.00		
b)	Brick Works - A-Class- 1500 PSI (Protection Cover) (3" thick)	Sqm.	954.59		
c)	Warning Tape Electrical (300mm x 0.5mm)	Rm.	51,133.00		
d)	Excavated earth back filling in layers of appropriate thickness and compaction at 90% of MDD as per modified AASHTO	Cum.	20,453.00		
4.3	Laying/fixing arrangement of drilling/ thrust boring method at road crossing by putting uPVC 8" dia pipe (Class-D) back filling and compaction for MV and LV Cables road crossing where road crossing sleeves are not available as per site requirement.	Rm.	100.00		
4.4	Laying/fixing arrangement of drilling/ thrust boring method at road crossing by putting uPVC 4" dia pipe (Class-D) back filling and compaction for MV and LV Cables road crossing where road crossing sleeves are not available as per site requirement.	Rm.	100.00		
	SUB - TOTAL OF B				
	TOTAL COST OF (A+B)				



Ravi Urban Development Authority

RAVI RIVERFRONT URBAN DEVELOPMENT PROJECT



INFRASTRUCTURE DEVELOPMENT AT CHAHAR BAGH

ELECTRICAL WORKS AT CHAHAR BAGH-I

DECEMBER 2024

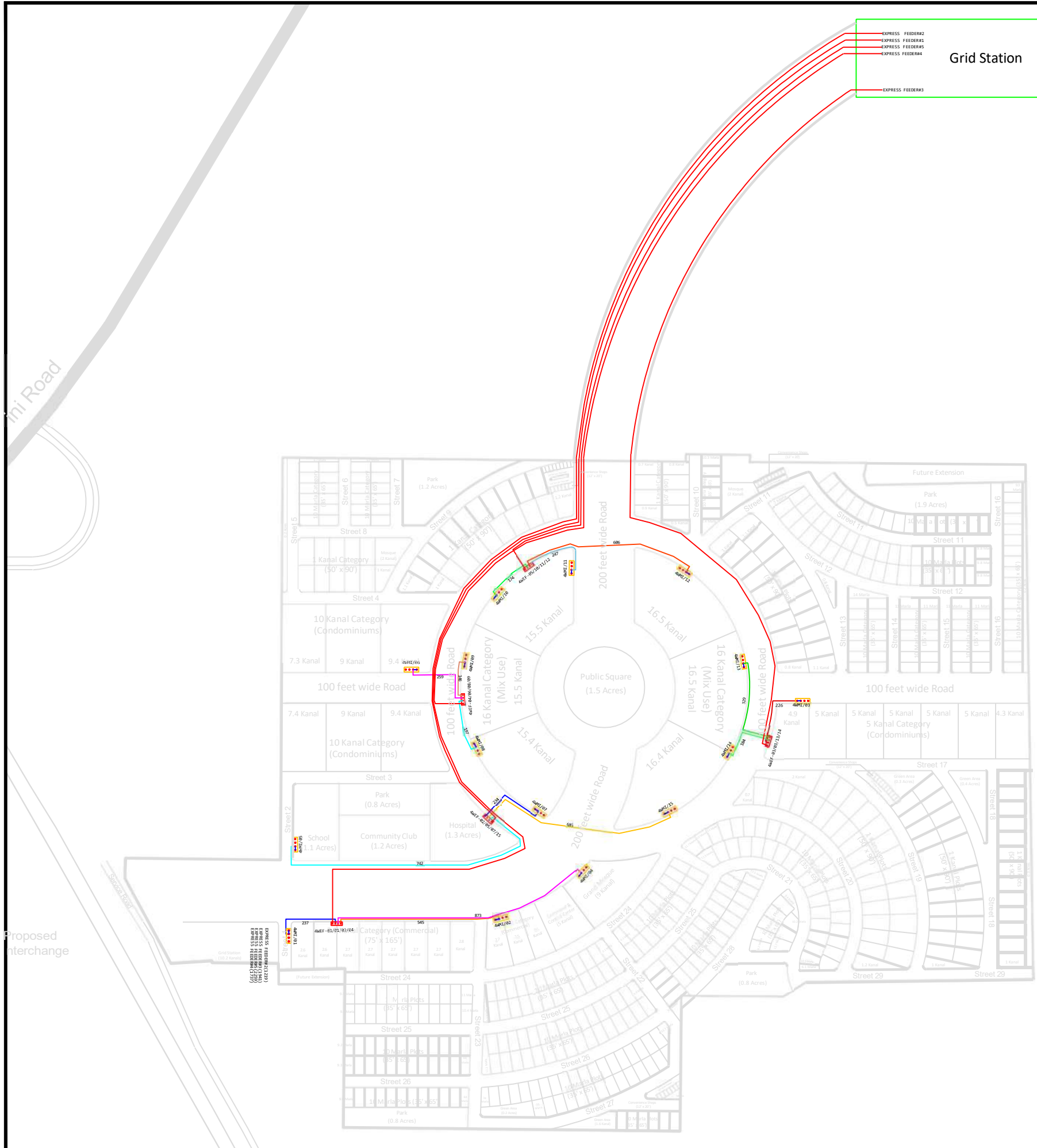
BIDDING DOCUMENTS – VOLUME IV

DRAWINGS



National Engineering Services Pakistan (Pvt.) Limited

Clearance Code	4678/13/BD/1224	Doc. No.	4678-04	Rev No.	00
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NOTES

- 1 - ALL ELECTRICAL INSTALLATIONS LOCATION INCLUDING 11kV RMUs, PAD MOUNTED TRANSFORMER(PMT), DISTRIBUTION BOX ARE TENTATIVE ONLY. THE SAME SHALL BE FINALIZED AT CONSTRUCTION STAGE.
- 2 - THE LOCATION OF ELECTRICAL EQUIPMENTS INSTALLATION INCLUDING 11kV RMUs, PAD MOUNTED TRANSFORMER (PMT) & DISTRIBUTION BOX ARE GIVEN AS TENTATIVE THAT MAY BE CHANGED DURING CONSTRUCTION STAGE AT SITE WITH THE APPROVAL OF THE ENGINEER.

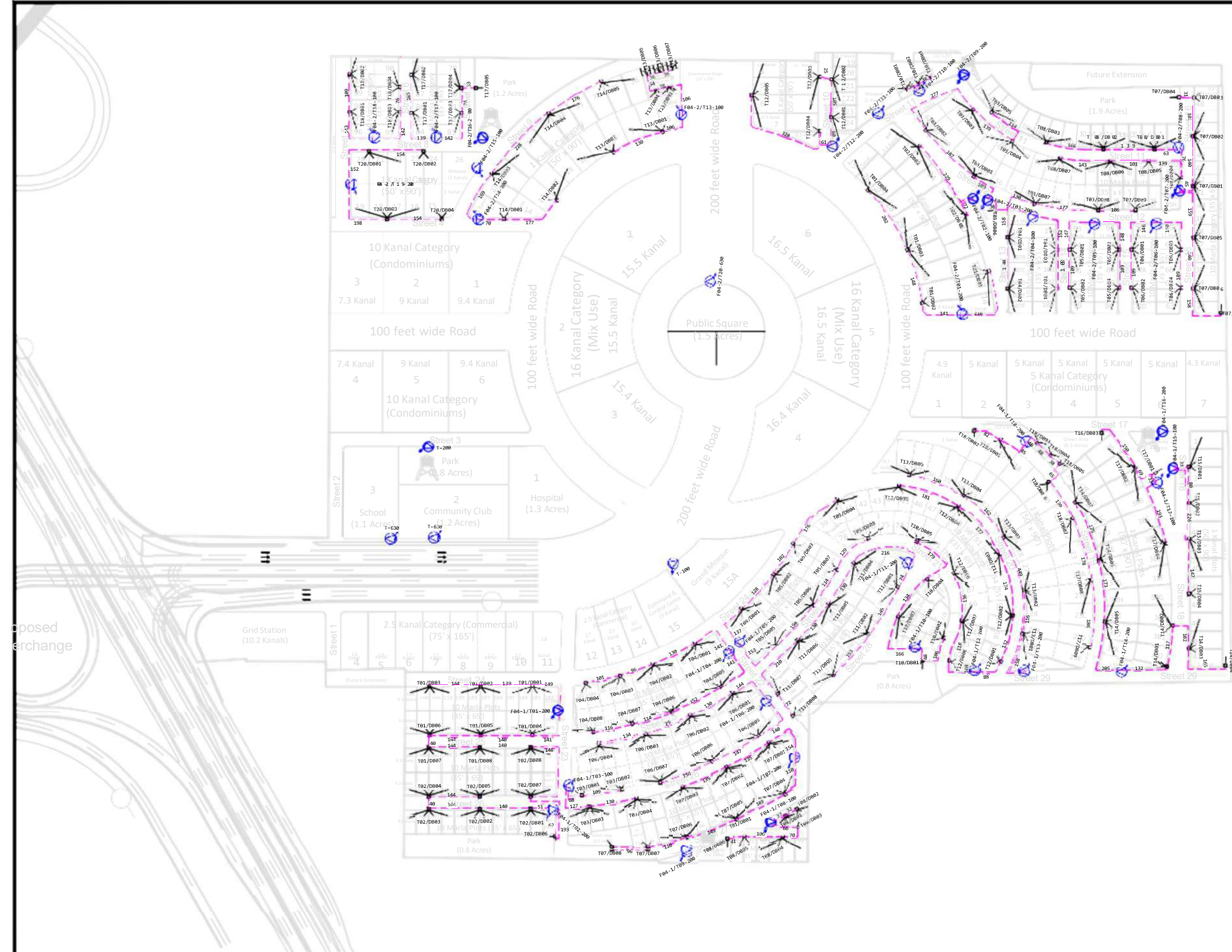
LEGENDS

S.NO.	DESCRIPTION	SYMBOL
1	4 WAY RMU TYPE SF6 SWITCHES (WITH MECHANICAL INTERLOCKING)	
2	4 WAY RMU TYPE SF6 SWITCHES	

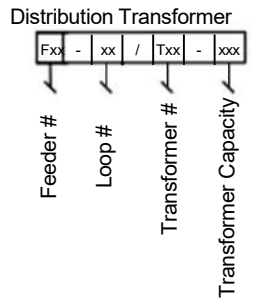
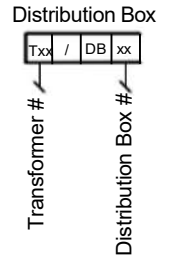
MV FEEDER

a - 3 Nos. 1-CORE 500 Sq.mm AL/XLPE/AWA/PVC (8.7/15kV).
GRID TO 4WAY SWITCH & 4WAY TO 4WAY SWITCH.

CLIENT  RAVI URBAN DEVELOPMENT AUTHORITY, LAHORE	CONSULTANT	04			DRAWN	SA	PROJECT	Title		SCALE			
	 NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	03			SUBMITTED						EXPRESS FEEDER LAYOUT PLAN		N.T.S
		02			RECOMMENDED								
	HEAD OFFICE:- NESPAK HOUSE, I-C, BLOCK-N, MODEL TOWN EXTENSION, LAHORE, PAKISTAN.	01	MAY, 2024	GRID STATION LOCATION REVISED AS PER CLIENT.		CHD./VER.			DATE		DRAWING No.	REV.	
		REV.	DATE	DESCRIPTION		APPROVED			JANUARY, 2024	4490/161/TD/5E003	1		



KEY



NOTES

- 1 - THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DISCIPLINE OF WORKS TO AVOID THE CONSTRAINTS AT SITE.
- 2 - THE LOCATION OF ELECTRICAL EQUIPMENTS INSTALLATION INCLUDING 11kV RMUs, PAD MOUNTED TRANSFORMER (PMT) & DISTRIBUTION BOX ARE GIVEN AS TENTATIVE THAT MAY BE CHANGED DURING CONSTRUCTION STAGE AT SITE WITH THE APPROVAL OF THE ENGINEER.

LEGENDS

S.NO.	DESCRIPTION	SYMBOL
1	PAD MOUNTED TRANSFORMER (PMT)	
2	DISTRIBUTION BOX WITH CONSUMER CONNECTION	
3	LV (0.6/1KV) 4-Core 300 Sq.mm AL/PVC/PVC Cable	
4	LV (0.6/1KV) 4-Core 185 Sq.mm AL/PVC/PVC Cable	

CLIENT



**RAVI URBAN DEVELOPMENT
AUTHORITY, LAHORE**

CONSULTANT



**NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT.) LTD.**

HEAD OFFICE:- NESPAK HOUSE, I-C, BLOCK-N,
MODEL TOWN EXTENSION, LAHORE, PAKISTAN.

04

03

02

01

REV.

DATE

DESCRIPTION

MAY, 2024

GRID STATION LOCATION REVISED AS PER CLIENT.

Title

DATE

JANUARY, 2024

DRAWING No.

4490/161/TD/5E001

REV.

1

**LV UNDERGROUND ELECTRIFICATION
NETWORK**

SCALE

N.T.S

PROJECT

**INFRASTRUCTURE DEVELOPMENT
AT CHAAR BAGH**

PROJECT

SA

DRAWN

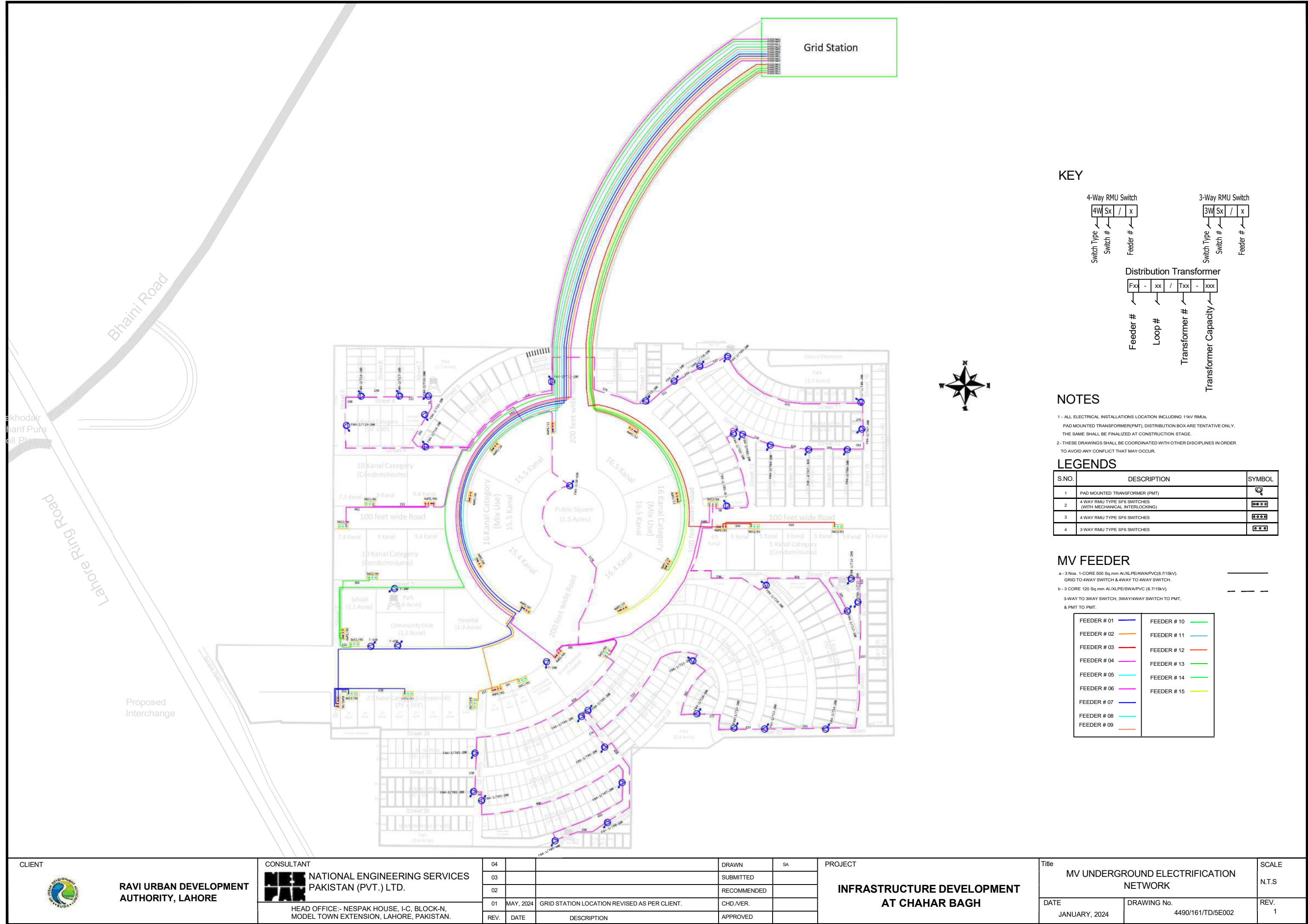
SUBMITTED

RECOMMENDED

CHD./VER.

APPROVED

GRID STATION LOCATION REVISED AS PER CLIENT.



SECTION - 1

GENERAL SPECIFICATIONS FOR ELECTRICAL SYSTEMS

1.0 SCOPE OF WORK

The scope of this contract covers all operation and activities required for proper and complete construction of electrification works for Design and Construction of waste water disposal system of Multan Industrial Estate.

The works related to the Electrical systems that are included in the scope of this Contract are shown on the Tender Drawings, stated in the Bill of Quantities and explained in these Specifications. All the equipment & allied accessories and their installation shall also comply with General Specifications described here-under, with other relevant provisions of Tender Document and WAPDA/other utilities' latest Specifications/Standards. Electrical & Communication systems shall broadly include but not limited to the following:

- Design, manufacturing, supply, installation, testing and commissioning of Lighting fixtures/Luminaries
- Design, fabrication, manufacturing, supply, installation, testing and commissioning of the Low Voltage 415 Volt three phase and 250 Volt single phase switchgears.
- Supply, installation, testing and commissioning of the Low Voltage Single / Multi core PVC/PVC & PVC/SWA/PVC Copper conductor cables in Cable trenches, underground pipes, on cable trays.
- Design, fabrication, manufacturing, supply, installation, testing and commissioning of the 415 Volt 50Hz Diesel Generator sets
- Design, fabrication, manufacturing, supply, installation, testing and commissioning of the Type 11/0.415 kV 50 Hz Indoor/ Outdoor Transformers
- Supply, installation, testing and commissioning of the Earthing of Electrical system.

The scope shall include the continuing of the contractor to remain responsible for removal of defects detected in the works and for achieving satisfactory operation/functioning/service of the works during defect liability period.

The contract shall include furnishing of all construction equipment, tools, labour, supervisory staff, plants, transport, power, testing apparatus/arrangements and all construction materials as shall be required for satisfactory completion of works strictly in accordance with the Technical Specifications and Bill of Quantities forming part of these Tender Documents

and as per levels and dimensions as shown on the drawings supplied with these tender documents and in drawings which may be supplied by the Employer from time to time under approved variation orders.

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these Documents but which is necessary for proper operation of the works/ system included in the scope of this Contract. The Contractor shall solely be responsible for ensuring proper functional requirements of various equipments. He shall also be responsible for furnishing any additional piece of equipment and for making modification in the equipment as desired and/or approved by the Engineer to achieve proper co-ordination with various other equipment's offered in the bid and also with those installed by others.

2.0 RULES & REGULATIONS

The entire Electrical & Communication systems installation/work shall be carried out by licensed Contractor, authorized to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified upto date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers-London, 16th edition, NEC 1999, the Contract Documents, the Electricity Rules 1937 and bye-laws that are in force from time to time.

Any discrepancy between these specifications and the standards/ regulations shall be brought to the notice of Engineer for his instructions and decision of the Engineer shall be final and conclusive.

The Contractor shall be responsible for completing all formalities and submitting the test certificates as per prevailing rules and regulations, and shall have the installation passed by the Government Electric Inspector of that region. All requirements of the Electric Inspector and the utility company WAPDA shall be complied with.

3.0 AMBIENT CONDITIONS

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material/equipment.

Minimum indoor ambient temperature:	Zero Degree Celsius
Maximum indoor ambient temperature:	+ 35 Degree Celsius
Minimum outdoor ambient temperature:	Zero Degree Celsius
Maximum outdoor ambient temperature:	+ 45 Degree Celsius

Maximum Relative Humidity: 70 Percent

Minimum Relative Humidity: 40 Percent

The atmospheric conditions are tropical and arid.

4.0 MARKINGS

The Contractor shall provide "Danger Boards" and "Shock Charts", wherever required, to comply with the requirements of local Electricity Rules and according to normal practice.

5.0 SYSTEM DATA

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate satisfactorily with the following minimum requirements with the specified tolerance without any derating

- | | | |
|----|--|---|
| a. | Voltage rating of equipments | MV15000V Three phase $\pm 10\%$ |
| b. | Voltage rating of equipments
LT & DG Sets | 500V Three phase $\pm 10\%$
250V Single phase $\pm 10\%$ |
| c. | DC voltages | 24V DC $\pm 10\%$
12V DC
Others |
| d. | Frequency | 50 HZ ± 2 HZ |

6.0 STANDARDS

The latest standards and codes of reputable organizations shall be applicable for the material and equipment specified herein and for installation work. Such organizations shall be British Standard Institution (BSS), International Electro technical Commission (IEC), IEEE and NEC. In case the Specifications laid down herein differ from those given in the standards, then the better specifications shall govern. Wherever applicable, the equipment shall also conform to the requirements of Pakistan Standards Institute (PSI) and Pakistan Telecom Authority (PTA).

7.0 MATERIALS & WORKMANSHIP

All materials, equipment, accessories, fixtures and fittings, under the scope of this Contract, shall be brand new and in accordance with the Tender Specifications and the specifications of the British Standards Institute and Pakistan Standards Institute. Samples and detailed manufacturers shop drawings (including dimensional plans, elevation, sections, line and wiring diagrams, foundation details, component characteristics and data etc.), shall be approved by the Engineer before purchase or fabrication. The Engineer

shall witness routine tests at the manufacturer's work sites and a test certificate shall be provided to him. Three copies of the test certificates at the manufacturer's works shall be supplied. All workmanship shall be first class and undertaken by workman skilled in the particular type of craft.

8.0 DEVIATIONS

The entire design of the Electrical systems of the project has been carried out to fulfill the Users requirements. The design is based on International standards/norms and practices. Special considerations have been made for ease in operation and maintenance of electrical systems of the project. Deviation may be allowed for the works covered under present scope of work, with the approval of Engineer/Client

9.0 EQUIPMENT AND MATERIALS

The equipment/materials of the Electrical systems of the tender have been designed using the latest editions of International Standards/Codes such as BS, ICE, NFPA, CP as mentioned in article 6.0 above. In these Specifications certain types/makes of equipments/ materials have been specified for the purpose of general reference and guidance of the Bidder. However, names of certain manufacturers/suppliers of electrical equipments/materials have been recommended for this project.

The names and addresses of these recommended manufacturers/suppliers are given in Annexure "A" of the tender documents. The Contractor is bound to supply and install the required equipments/ materials only from the recommended manufacturers/ suppliers.

In case, if at a later stage in project, the contractor wishes to substitute the specified equipment or materials, he shall furnish complete details of equipment/substitute to materials.

The equipment/substitute equipments/materials will only be considered by the Engineer if he is satisfied that the equipment/substitute material have technically equivalent/better specifications. In case if the Engineer feels that the equivalent/substitute materials are of less cost compared to the specified materials then the contractor shall give comparative discount in the contract value of the BOQ items.

In case the cost of equivalent/substitute item is more the than the cost of BOQ item then no cost adjustment shall be made in the relevant BOQ item. Once the equivalent/substitute materials are recommended for approval by the Engineer the same shall be forwarded to the Employer/Client for their approval. The equivalent/substitute materials shall only be accepted after the Client's final approval.

All materials and equipments being provided by the Contractor & the Sub-contractor shall be interchangeable to the maximum extent with respect to makes, types, model etc.

10.0 DRAWINGS, AND DATA TO BE FURNISHED BY THE CONTRACTOR

Submittal

The contractor, after the award of work, shall submit for approval of the Engineer all drawings and cuts of equipment, appliances, fixtures and accessories that are to be furnished under the contract. After final approval, a sufficient number of copies as desired shall be furnished for distribution. Manuals, cuts, catalogues and drawings shall be clearly marked to indicate, the items furnished. Cuts of all fixtures, and not a few, shall be submitted.

Approval of Drawings and Data

The Contractor shall provide detailed electrical drawings, wiring diagrams, foundation details etc. for all electrical and other systems etc. for the Engineer's review and approval.

The manufacturing of electrical equipment shall be started only after the above mentioned drawings and data are approved.

The time required for review and approval shall be considered included in the total time of completion of job.

Three sets of drawings and data for each equipment shall be furnished by the Contractor for the Engineer's approval before commencement of fabrication and manufacturing. The drawings to be supplied by the Contractor shall be as follows:

- Arrangements
- Dimensional plans, elevations and front view
- Foundation plan, anchors and configuration
- Incoming and outgoing cable termination positions
- Earthing arrangement
- Electrical Drawings showing:
 - Single-Line diagram
 - Detailed wiring diagram
 - All interconnections
 - Other electrical devices including meters, instruments and their wiring diagram.
 - Signal and alarm circuit

Shop Drawings

The locations, routing and installation heights of the equipment etc. which are given on the tender drawings, are approximate. These drawings depict only the position of various fixtures and outlets. All the detailed planning for electrical and communication systems including conduit routes etc. shall be carried out well in advance of the actual execution of work, by the Contractor to the satisfaction of the Engineer. For this purpose the Contractor shall

prepare shop drawings and obtain prior approval of the Engineer. Three prints of each shop drawings shall be submitted for obtaining approval. No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each distribution board. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

As-Built Drawings

Clearly annotated "As-Built" electrical drawings and diagrams shall be maintained upto date on site on completion of the Job. One reproducible and three prints of each drawing shall be submitted to the Engineer alongwith a recommended maintenance schedule chart and manuals/operating instructions for equipment supplied. The Contractor shall also provide complete detailed identifications of MV incoming and LV outgoing circuits, in the form of line drawings, for each pad mounted transformer. The line drawings shall be made on 20 SWG sheet metal work. The line drawings shall be clearly identified with permanent colors. The MV and LV circuits shall have different colors. The sheet metal work shall be of suitable dimensions so as to be fixed on the inside of the door of the LV compartment of the pad mounted transformers. The line drawing shall be fixed with the help of rivets for permanent installation.

11.0 PRODUCT DELIVERY, STORAGE AND HANDLING

All equipment shall be boxed, crated or otherwise enclosed and protected during shipment, handling, storage and after installation until final acceptance of the equipment. Electrical materials shall be delivered in manufacturer's original cartons or containers with seals intact, as applicable. Large multi-component assemblies shall be delivered in sections that facilitate field handling and installation.

Unless designed for outdoor use, all equipment shall be kept dry, off the ground and covered from exposure to weather. Electrical equipment and equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities. Heaters in equipment shall be connected and operated until the equipment is placed in operation. The Contractor shall prevent corrosion, contamination or deterioration of stored equipment.

Equipment and materials shall be handled in accordance with manufacturer's recommendations. Large or heavy items shall only be lifted from the designated points. Padded slings and hooks shall be used for lifting to prevent damage.

All equipment shall be protected until final acceptance and all factory surfaces must be protected from impact, abrasion, discolouration and other damage. All damaged equipment must be repaired or replaced before final acceptance.

12.0 MANUFACTURER'S INSTRUCTIONS

The Contractor shall supply to the Engineer Three (3) copies of manufacturer's instruction manuals in properly bound form for installation, testing, commissioning, operation and maintenance of the specified equipment including manuals of spare parts and tools of the equipment. One copy of the documents shall be submitted in original. The installation instructions shall be submitted four (4) weeks prior to commencement of installation of each equipment and operation & maintenance instructions at least two (2) weeks before the time of commissioning. If the contractor fails to provide the documents, the Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.

13.0 GUARANTEE

In addition to the Contractor's guarantee and liabilities for satisfactory operation of the works, wherever advised by Engineer, the Contractor shall also furnish written guarantee of the manufacturer or supplier with respect to satisfactory performance of each equipment. Guarantee shall be given for replacement and repair of part or whole of the equipment that may be found defective in material or workmanship. The guarantee shall as a minimum cover the duration of Maintenance Period as defined in the Conditions of Contract. This guarantee shall not relieve the Contractor of his obligations and he will be fully responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/or replacements.

14.0 INSTALLATION INSTRUCTIONS

The Contractor shall furnish all labor, materials, tools and equipment required to install, connect, test and commission all electrical equipment specified herein, whether or not such equipment is furnished by him or by others.

For all equipment to be installed by the Contractor, the Contractor shall supply and install all erection materials such as foundation bolts, washers, nuts etc. as required and without any additional costs.

The Contractor shall set out the works himself as per Specifications and Drawings and shall properly position the equipment on specified foundation/location. In general, the manufacturer's instructions for installation shall be followed.

Any defect or faulty operation of equipment due to the Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost as per these specification and to the satisfaction of Engineer.

For any deviation from the working drawings that are deemed necessary by the Contractor due to site conditions, he shall submit the details and obtain the Engineer's approval before starting such works.

15.0 PRESHIPMENT INSPECTION AND TESTING

15.1 General

Equipments and materials covered in the scope of this contract are subject to pre-shipment inspection & testing at the manufacturer's factory/works. The Contractor, in coordination with the manufacturers of relevant materials shall arrange for the pre-shipment inspection & testing by the Engineer or his authorized Representative at the manufacturer's factory/works. The Contractor shall make all necessary arrangements and cater for all expenses in this regard for the traveling, boarding and lodging of the Engineer or his authorized Representative plus daily allowance @ Rs. 2,000 per day per person within Pakistan and US \$ 200 per day per person outside Pakistan for the pre-shipment inspection and to witness the tests at the manufacturer's factory/works.

15.2 Pre-shipment Factory Tests

15.2.1 MV & LV Switchgear, Generators, Transformers, Maintenance-Bypass Switch & Communication Systems Equipment

All type and routine tests on all equipment, materials and switchgear shall be performed at the manufacturer's works in the presence of the Engineer or his Representative. Type tests may be waived off in case test certificates, certified by an approved standard laboratory of international repute, approved by the Engineer, are submitted. But merely producing the type test certificates shall not relieve the Contractor and the manufacturer to carry out the required tests.

The Contractor shall obtain from the manufacturer and submit to the Engineer for approval, the complete details of tests to be performed describing the procedures, test observations and expected results.

The Contractor shall ensure availability of all tools, instruments, test equipments, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all equipments and materials including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident

during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four (4) copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams etc.

The Contractor shall inform the Engineer about the place, date and time of test of each equipment at least, two (2) weeks in advance. The witnessing of test by the Engineer or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment, and for furnishing the guarantees referred to in Clause 8.0. All test results shall be supplied in quadruplicate.

15.2.2 Insulation Resistance Test

Insulation resistance test shall be made on all electrical equipment by using a meggar of 500 volts for circuits upto 250 volts and meggar of 1000 volt for circuits between 250 and 500 volts. The Engineer shall advise the exact testing voltages. The insulation resistance values of cables, switchgear etc. shall be as per BSS, IEC, ICEA and Pakistan Electricity Rules.

15.3 Field Tests

15.3.1 General

Upon completion of the installation, the Contractor shall perform field tests on all equipment, materials and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment and system's compliance with Specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the procedure test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials etc. and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the

Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of the Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four (4) copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment diagrams etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship or as any other obligations of contract.

15.3.2

Insulation Resistance Test

Before making connections at the ends of each cable run or joint between cables, the insulation resistance test of each cable section shall be made. Each conductor of a multicore cable shall be tested individually with each of the other conductor of the group and also with earth. If insulation resistance test readings are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and tests repeated on new cable. If cable joint is provided, then each cable section shall be tested and joint made only after the tests have been made satisfactorily. Finally the completed cable length including the joints shall be tested.

All switchgear shall be given an insulation resistance test after installation, but before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than the specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all

tests have been made, the equipment shall be reconnected as required.

15.3.3 Earth Resistance Test

The Contractor shall make Earth resistance tests on the earthing system, separating and reconnecting each earth connection.

If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the ECC together with the resistance of the earthing leads measured from the connection with earth electrode to any other position in the complete installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earth electrodes are installed, the earth resistance test of each electrode shall be measured.

The complete lightning protection system shall be tested for continuity and earth resistance. The combined earth resistance at any point in the lightning protection system shall not exceed ten (10) ohms.

15.4 Completed Tests

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment does not cause any damage to the already tested equipment.

16.0 ASSOCIATED CIVIL WORKS

The cost of all civil works which are associated with any BOQ item are deemed to have been included in the respective items of Bill of Quantities unless specifically stated otherwise. The civil works shall include excavation, backfilling of earth, compaction of the earth, foundation pads, grouting, chiseling, making openings etc. Such works will also include repair of any damage to civil works caused by the Contractor during electrical installation.

17.0 EXPENSES TO BE BORNE BY THE CONTRACTOR

All expenses regarding travelling, boarding, lodging and witnessing of tests by the Engineer or his representative and/or the owner or his representative

including costs for carrying out the required tests shall be borne by the Contractor and are deemed to have been included in the Tender Bid.

18.0 TEST CERTIFICATES TO BE FURNISHED BY THE CONTRACTOR

After all field tests have been carried at site, the Contractor shall furnish test certificates for the following equipments and materials as supplied and installed by the contractor;

- Lighting fixtures
- MV & LV Switch Boards & Distribution Boards
- MV & LV Power cables
- Diesel Generator Sets
- Power Transformer (11/0.415kV)
- Earthing system

19.0 PAYMENT

No separate payment shall be made for work involved within the scope of this section, unless specifically mentioned in the respective items of Bill of Quantities.

SECTION - 2

SWITCH FITTINGS & ACCESSORIES

1. GENERAL

The work under this section consists of supplying, installing, and commissioning of all material and services of the complete switch fittings and accessories as specified herein, as shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of all electrical equipments.

The switch fittings and accessories shall also comply with the General Specifications for Electrical & Communications Works Section-8001 and with other relevant provisions of the Tender Documents.

The Light control switches, switch socket units, Fan Controllers, Industrial socket units, etc. shall be of following ratings;

- Light Switches rated for 10A, 250 Volt
- Fan dimmers rated for 100W, 250 Volt
- Shuttered 3 pin rated for 15A, 250 Volt
- Shuttered 3 pin rated for 20A, 250 Volt

The locations of the switch fittings & accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure the exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer.

2. APPLICABLE STANDARDS/CODES

The latest edition of following standards codes shall be applicable for the materials within the scope of this section:

- | | | |
|---------|---|--|
| BS 2135 | - | Capacitors for radio interference suppression |
| BS 546 | - | 3 pin plugs, socket outlets and socket outlet Adapter for circuits up to 250 volts |
| BS 67 | - | Two and three terminal ceiling roses |
| BS 4934 | - | Safety requirements for electric fans and regulators |

BS 5060 - Performance of circulating fans and their regulators

3. MATERIAL

3.01 One Way Switches - Indoor type

Switches for controlling light points shall be single pole, rated for 10 Amps, 250 Volt AC. The body of the switches shall be suitable for flush mounting on PVC back box/outlet box. The switches shall have screw contacts and shall operate with snap action.

3.02 Two Way Switches - Indoor Type

Two way switches for control of lights shall be of same make and specifications as for one way switches above, except these shall be of use to control light circuits from two different locations.

3.03 Switched Socket Outlets

Switched Socket units shall be of the following combinations and ratings:

- Shuttered 3 pin rated for 15A, 250 Volt
- Shuttered 3 pin rated for 20A, 250 Volt

Front face plate shall conform to the requirements stated above for switches - indoor type. The outlets shall be heavy duty type suitable for mounting on PVC outlet box. The 3 pin 15 Amps and 3 pin 20 Amps sockets shall have shrouded live contacts and designed such that the earth pin of plug is engaged to socket earth before mating of live contacts.

3.04 Fan Controller

Fan Controller for fan speed regulating shall be suitable for ceiling fans, rated for 10 Amps, 250 Volt AC. The body of the fan controller shall be suitable for flush mounting on PVC back box/ outlet box. The fan controller shall have ON/OFF switch that shall operate with click action.

3.05 Outlet Box

The outlet boxes for installation of switches, dimmers and socket outlets shall be of PVC having appropriate dimensions. The box shall have suitable arrangement for receiving the conduit.

4. INSTALLATION

4.01 General

The mounting heights of all wiring accessories fixtures are stated on the Drawings. In case the mounting height is not mentioned, the instructions of the Engineer Incharge shall be obtained before fixing.

4.02 Light Control Switches

The Light Control Switches shall be installed directly on back boxes/outlet boxes recessed in CC/RCC walls or columns. The fixing of Light Control Switches shall be by means of screws provided with them so as to finish flush with the surface.

4.03 Switched Socket Outlets

The Switched Socket Outlets shall be installed directly on back boxes/outlet boxes recessed in CC/RCC walls or columns. The fixing of Switched Socket Outlets shall be by means of screws provided with them so as to finish flush with the surface.

4.04 Fan Controllers/Light Dimmers

The Fan Controllers/Light Dimmers shall be installed directly on back boxes/outlet boxes recessed in CC/RCC walls or columns. The fixing of Fan Controllers/Light Dimmers shall be by means of screws provided with them so as to finish flush with the surface.

5. MEASUREMENT AND PAYMENT

5.01 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

5.02 Light Control Switches

5.02.1 Measurement

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting,

testing and completion of each type and rating of the Light Control Switch including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

5.03 Switched Socket Outlets

5.03.1 Measurement

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

5.03.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of the Switched Socket outlet including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

5.04 Fan Controllers

5.04.1 Measurement

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

5.04.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of Fan Controller unit including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

5.05 Light Dimmers

5.05.1 Measurement

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

5.05.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each type and rating of Light Dimmer unit including PVC outlet box, nuts, bolts and other accessories as required for complete installation.

SECTION - 3

CONDUITS AND PIPES

1.0 GENERAL

The work under this section consists of supplying, installing, and commissioning of all material and services of the complete conduits and pipes as specified herein, shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the layout with the Engineer and co-ordinate at Site with other services for exact route, location and position of the conduits and pipes for electrical lines.

The conduits and pipes with accessories shall also comply with the General Specifications for Electrical Works Section-1 and with other relevant provisions of the Tender Document.

The extent of work shown on the Drawings does not indicate the exact position of conduits and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services Drawings, as per site requirements and as directed by the Engineer.

2.0 APPLICABLE STANDARD/CODES

Latest editions of the following standards/codes shall be applicable for the materials in scope of this Section:

- | | | |
|---------|---|------------------------------|
| BS 6099 | - | PVC conduits and accessories |
| BS 3595 | - | PVC pipes & accessories |
| BS 4346 | - | Cement Solvent for jointing |

3.0 MATERIAL

3.01 PVC Conduits and Accessories

The heavy gauge PVC conduits and accessories conforming to BS6099 shall be generally used. The PVC conduits and accessories of light gauge may be used on the project with the concurrence of the Engineer.

The PVC bends, sockets, elbows, couplings etc. shall conform to the same specifications as for the conduits. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where

conduit changes direction. Bending of conduits by heating or otherwise will not be allowed in any situation. The use of sharp 90-degree bends and tees will not be allowed for concealed wiring.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 63-mm diameter and depth. The junction boxes for wall light points shall have minimum dimensions of 63-mm diameter and 38 mm deep. Round junction boxes shall be provided with one piece PVC cover plate fixed to the box by means of brass screws.

3.02 PVC Pipe and Accessories

The PVC pipe shall be rigid. All pipes shall be minimum Class D (Working pressure - 12 bar), unless otherwise stated on drawings or bill of quantities. The buried PVC pipe should be able to withstand the external load acting upon it by continuous movement of heavy duty vehicles such as trucks, cranes, forklift, etc. Where pipe changes direction, manufactured smooth bends shall be used. Bending of pipes by heating or otherwise will be allowed in special cases only. Bending of pipes by heating shall be carried out by first filling the pipe with sand inside and then immediately removing the sand. The use of sharp 90-degree bends and tees will not be allowed. The bends shall conform to same specifications as given for PVC conduits. For joining of pipe all precautions and procedures recommended by manufacturer shall be followed.

4.0 INSTALLATION

4.01 Concealed Conduits

Where concealed conduit system is to be installed as stated on drawings, the conduit shall be installed concealed in roof, wall, column, etc. Conduits shall be laid underfloor only where specifically stated.

When concealed, the conduit shall have a minimum of 32-mm cover of concrete measured from the top of conduit to finished surface. In the reinforced cement concrete (RCC) work the conduit shall be laid before pouring of concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and Accessories after pouring of concrete. The conduit shall be supported on top of bottom reinforcement of slab. All outlet boxes shall be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting or in block masonry work, chase shall be made with appropriate tools and shall not be made deeper than required. The conduit

shall then be fixed firmly in the recess and covered with cement concrete mixture. The work of cutting in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from the Engineer before starting chasing and cutting.

The termination of conduits shall be at or near the equipment switchboard as shown diagrammatically on the Drawings. The exact locations of the termination shall be coordinated with the equipment/switchboard to be installed. Any extension of conduit to suit the site condition shall be made without any extra cost. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against falling concrete. At all terminations of conduit, sharp edges of conduit ends shall be prevented to avoid the cutting or damaging of wire or cables during pulling through the conduits.

Underfloor conduit shall be installed at a minimum depth of 2 inches from the finished floor level or as shown on the Drawings. The conduits shall be installed empty before finishing of floor or in RCC work with a 18 SWG steel wire drawn through the conduit for pulling cable. No conduits shall be laid under floor in bathroom.

The entire conduit system shall be installed and checked before wiring as carried out. Any obstruction found shall be cleared before the installation of cable. Pull boxes and adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements.

- Pull boxes

For straight runs the spacing shall not be more than 180 feet

For runs with one 90 degree bend the spacing shall not be more than 90 feet

For runs with two 90 degree bends the spacing shall not be more than 40 feet

- Adaptable boxes

For conduit upto 1-inch dia. the boxes shall be 2 inch in depth

For conduit upto 1-1/2 inch dia. the boxes shall be 2-1/2 inch in depth

For conduit upto 2-inch dia. the boxes shall be 3-1/2 inch in depth

The rectangular inspection boxes or pull boxes shall be 18 SWG heavy gauge sheet steel of suitable design to receive conduits. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than four times the cable manufacturer's recommended bending radius of the cable. All concealed type pull boxes shall have a white plastic sheet of appropriate size fixed to the box by means of galvanized screws.

Adaptable boxes shall be 18 SWG sheet steel and painted and finished to the same quality as the Lighting distribution boards.

Wherever the conduit lengths cross the expansion joint either along the columns or slab, suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed the conduit shall not crack or break.

4.02 **PVC Pipe**

Rigid PVC pipes shall be installed under roads and paved areas, at crossing with other services and at cable entering building as shown on the Drawings. The depth of the pipe shall vary according to the conditions at site, and approval of Engineer shall be obtained prior to installation. In general the pipes shall be installed underground at the following depths measured from the top of the pipe:

- | | | |
|----|--|---|
| a) | Under roads and paved surface | 800 mm below the finished surface |
| b) | When crossing other services for the crossing length | 250-mm vertical clearance
500 mm horizontal clearance with CC protective cover |

The trench of required dimensions shall be excavated and the bottom of trench cleaned and leveled. A four-inch thick bed of fine sand shall be provided over which the PVC pipes installed after proper alignment. Where two or more pipes are installed in the same trench the clearance between pipes shall not be less than two inches. After laying of pipe the trench shall be backfilled with clean-screened earth in layer of four inches. Each layer shall be properly compacted.

Where underground cables enter connection terminal boxes the PVC pipe shall be installed on surface by means of PVC clamps at a maximum interval of eighteen inches.

After installation, the ends of the pipe shall be plugged with material impervious to water and chemicals. All joints shall be sealed adequately to prevent entry of foreign elements.

The installation of pipes shall be completed in all respects including its fixing at terminations, before cabling work is started. All sharp edges and burrs shall be removed by using reamer or any approved device. The pipe shall be thoroughly cleaned of dirt and dust from inside. The pipes shall be installed in proper co-ordination with other works.

5.0 MEASUREMENT AND PAYMENT

5.01 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation and completion for all work specified herein and as shown on the Tender Drawing related to the item.

5.02 PVC Conduits

5.02.1 Measurement

Measurement shall be made for the number of running metres of conduits acceptably supplied and installed by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing and completion of the laying of the conduits including jointing materials and accessories. The complete work wherever applicable shall include cutting/chasing of civil work for concealed conduit system, excavation and backfilling of ground for underground pipes, painting, plugging, bitumen coating, etc. as applicable for each type of work.

5.03 PVC Pipes

5.02.1 Measurement

Measurement shall be made for the number of running metres of pipes acceptably supplied and installed by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing and completion of the laying of the PVC pipes including jointing materials and accessories.

SECTION 4

EARTHING

1. GENERAL

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories of the complete earthing system as specified herein, as shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and Co-ordinate at Site with other services for exact route, location and position of the electrical lines and equipment.

The earthing system shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Tender Documents and latest WAPDA Specifications.

The earthing system consists of earth electrodes, earthing leads, earth connecting points, earth continuity conductors and all accessories necessary for the satisfactory operation of the associated electrical system.

2. APPLICABLE STANDARDS/CODES

The latest editions of following standards/codes shall be applicable for the materials in scope of this section:-

BS 951	-	Earthing Clamps
CP 1013	-	Earthing
BS 2874	-	Nuts, bolts, washers, screws & rivets fixing for use on Copper
BS 1433	-	Hard drawn bare copper conductor for earthing
BS 6346	-	PVC insulated cables

3. MATERIAL

3.01 Earth Electrode (Plate Type)

The earth electrode shall comprise a two feet x two feet and 1/8 inch thick electrolytic copper plate. The surface of the plate shall be tinned for protection. The plate shall have four terminals for connecting of the

earthing leads. Nuts, bolts and washers, shall be either of brass or tinned copper.

3.02 **Earth Electrode (Rod Type)**

The earth electrode shall comprise ten feet long, 5/16 inch dia. copper deposited steel rod having flat head at drive end and pointed conical tip at the driven end. The tip shall be hardened to facilitate driving. At the top of the pipe, a clamp for bolted connections shall be provided suitable for connection to the down conductor.

3.03 **Earthing Lead**

The earthing lead shall connect the earth electrode to earth connecting point on the high mast. It shall be round hard drawn bare electrolytic copper of size shown on the Drawings.

3.04 **Earth Continuity Conductor**

Earth continuity conductor (ECC) shall be hard drawn bare copper wire or single core PVC insulated copper conductor cable of sizes indicated on the Drawings.

The specifications for single core PVC insulated or PVC/PVC cables used as ECC shall be same as those in relevant sections of Technical Specifications.

3.05 **Earth Connecting Point**

Earth connecting points shall comprise tinned copper bar, rectangular in shape, having dimensions of 350 x 50 x 6 mm. Atleast, six terminals for connection shall be arranged on the bar, which can be increased or decreased as required by the engineer.

The terminals shall have brass or tinned copper bolts, nuts and washers for protection against corrosion. Two holes shall be provided off centre of the copper bar for fixing to the wall by means of 10 mm dia. nut and bolt and shall be insulated by means of rubber gaskets/washers.

4. INSTALLATION

4.01 **General**

Complete earthing systems as shown on the Drawing shall be installed by the Contractor. The earthing system shall have earth resistance, including the resistance of soil, earth leads and ECC of less than **One** ohm.

At all connections of earth continuity conductor to high mast or any other metallic body, proper size copper or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or terminations shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

The earth continuity conductor shall in general run in cable trench or in conduits/pipes as shown on the Drawings. For under floor runs, these shall be installed in pipe/conduit of appropriate sizes. Where laid along underground cables, these shall be laid directly underground in unpaved areas and in pipes under paved areas.

4.02 Earth Electrode (Plate Type)

The electrode plate shall be installed at a minimum depth of 15 feet from finished ground level or 3 feet below permanent water level whichever is less. The minimum horizontal distance between earth electrodes shall be 12 feet. Proper mixture of lime and charcoal shall be made and buried along with the copper plate in the ground to increase the soil conductivity. The earthing leads shall be installed in proper size G.I. pipes. The electrode shall be installed as per details shown on the Drawings.

4.03 Earth Electrode (Rod Type)

In case the soil conditions at site permit, the earth electrodes may be installed by hammering the electrode in soil, until the top of the rod is about 12 inches below the proposed ground level. If hammering down is not possible due to site conditions, a pit shall be first excavated in bare ground upto the required depth and electrode shall be installed upright in the pit. The excavated pit shall be backfilled in layers of 20 inches, each layer tamped and compacted. At the ground level an inspection chamber of cement concrete shall be constructed having dimensions as shown on the Drawings. The inspection chamber shall have a cover supported on angle iron frame. The cover shall be approved by the Engineer and shall finish flush with the ground level.

4.04 Earth Continuity Conductor

The earth continuity conductor of sizes shown on the drawing shall be installed all along the cable runs and connected to the earthing bar/terminals provided in equipment. The body of all switchboards shall also be connected to earth by specified size of ECC. All other metal work shall also be connected to earth by specified size of ECC.

At any joint or terminations, the ECC shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

4.05 Earth Connecting Point

The earth connecting point shall be installed at locations shown on the drawings. It shall be fixed on wall surface by means of brass screws.

5. MEASUREMENT AND PAYMENT

5.01 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation, testing and commissioning of all work specified herein, as shown on the Tender Drawing related to the item.

5.02 Earth Electrode

5.02.1 Measurement

Measurement shall be made for each type of earth electrode acceptably supplied and installed by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of earth electrodes including earthing leads, excavation, backfilling, inspection chamber with cover, G.I. pipes for earthing leads, nuts, bolts, washers, lugs, brazing and all related civil works.

5.03 Earth Continuity Conductor

5.03.1 Measurement:

Measurement shall be made for the number of running metre for each size of earth continuity conductor (ECC) acceptably supplied, installed and tested by the Contractor.

5.03.2 Payment

Payment shall be made for the total number of running metres of each size of ECC measured, as provided above, at the Contract unit price each and shall include full compensation for supplying, installing, connecting, testing and completing of ECC including all accessories, such as sockets, thimbles, lugs, bolts, nuts, brazing etc.

5.04 Earth Connecting Point

5.04.1 Measurement

Measurement shall be made for each earth connecting point acceptably supplied and installed by the Contractor as a complete unit.

5.04.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the contract unit price each and shall constitute full compensation for supplying, installing and completion of earth connecting point and all other associated accessories such as nuts, bolts, washers, lugs etc.

SECTION - 5

LOW VOLTAGE CABLE

1. GENERAL

The work under this section consists of supplying, installing, testing and commissioning of all material and services of Low Voltage cables and the accessories as specified herein or as shown on the Tender Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the electrical lines.

The LV cables with accessories shall also comply with the General Specifications for Electrical Works Section-1 and with other relevant provisions of the Tender Document and latest WAPDA specifications.

All single core PVC insulated cables for the following shall be of 600/1000 volt grade copper conductor cables;

- wiring of light circuits
- switch to point wiring
- light point to light point wiring
- wiring of circuits for 5 amps, 250 volt, 2&3 pin switch socket unit
- wiring between 5 amps, 250 volt, 2&3 pin switch socket units
- wiring of push buttons & between push buttons
- wiring of light circuits controlled by push buttons
- wiring between light circuits controlled by push buttons

All single core PVC insulated power cables for the following shall be copper conductor and of 600/1000 volt grade:

- wiring of circuits for 15 amps, 250 volt, 3 pin switch socket unit
- wiring of circuits for 20 amps, 250 volt, 3 pin switch socket unit

All multicore armoured/unarmoured control cables shall be copper conductor and of 300/500 volt grade.

All multicore armoured/unarmoured power cables shall be copper conductor and of 600/1000 volt grade.

All multicore armoured power cables shall be copper conductor and of 600/1000 volt grade.

2. APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials within the scope of this section:

BS 6004	-	PVC insulated cables (non-armoured) for electric power & lighting
BS 6346	-	PVC insulated cables for electricity supply
BS 6746	-	PVC insulation and sheath of electric cables
BS 6360	-	Conductors for insulated cables
IEC 60228	-	Conductors for insulated cables
BS 6500	-	Insulated flexible cords

3. MATERIAL

3.01 General

The power, lighting and control cables shall be furnished and installed in accordance with the details shown on the Drawings. The general guide lines and criteria for reference is given below:

3.01.1 Phase Identification

All cables shall have phase identification colors on insulation of each core. The colour code for three phase circuits shall be;

- Red, Yellow and Blue for phase conductors
- Black for neutral conductor
- Green for earth conductor where PVC insulated cable is installed.

Single phase circuits shall have insulation of;

- Red colour for phase/line
- Black colour for neutral
- Green colour for earth conductor.

All DC circuits shall have insulation of;

- Red colour for positive conductor
- Black colour for negative conductor
- Green colour for earth conductor.

3.01.2 Cable Accessories

All accessories shall be provided for the complete cabling and wiring systems. These shall include but not limited to items such as saddles, clamps, fixing channels, connectors, cable joints (where necessary and as approved by the Engineer), clips, lugs, tapes, solder, identification tags, bushes, glands etc.

4. INSTALLATION

4.01 Conduit Wiring

The wiring through conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes etc., are fixed in position.

The wires shall be pulled in conduit with care, preferably without the use of any lubricant. Where necessary and after approval of Engineer, the cable manufacturer's recommended lubricant shall be used. Use of any kind of oil or soap will not be permitted. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than ten times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body, sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable/wire shall be provided at each termination to facilitate repairs in future.

4.02 Cables on Surface

All cables for installation on surface of wall, column, ceiling etc., shall be fixed to the surface by means of galvanized steel clips secured to a

steel channel by means of suitable stud plate, nuts and washer. The distance between each cable clip shall be such, so as to support the entire weight of the cable and that distance between the cable and surface and also the vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting channels are to be furnished for cable along the same route. The Engineer before commencement of installation shall approve alternate cable fixing arrangement, which the Contractor can offer.

4.03 Cables in Flexible/Rigid Conduits on Surface

All cables for 'on surface conduits' shall be installed through the conduits without the use of lubricants. The flexible/rigid conduits shall be fixed to wall/ceiling surface by means of cable clamps using rawl plays and galvanized screws.

4.04 Underground Cable

The cables to be installed directly underground shall be laid in trench in single tiers. The depth of cable under ground, shall be three feet minimum, measured from the top of the largest cable to the general ground level. The burial depth may be increased as required due to site conditions or when crossing other service pipes and roads. Burial depth less than three feet and more than five feet shall require Engineer's approval.

When cables cross road, paved area, other services or other cables they shall be laid in protective pipes of required size. Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables shall be plugged water tight by means of bituminised resin or equivalent method as approved by the Engineer. A minimum clearance of ten inches vertically and 20 inches horizontally shall be maintained between cables and other services.

Cable identification tags of corrosion resistant material shall be tied to cables with bronze wire at a maximum of 65 feet interval along the cable length for identification of cable and circuit. Above ground cable markers of 8 SWG (4 mm) sheet steel and 200 mm² shall be erected at 100 feet intervals along the straight trench, and at each bend and joint box for indication of presence of underground cable. For more than three feet wide trenches, cable markers shall be provided at both edges of the trench. The cable marker shall be finished in gray heavy enamel paint over two base coats of anti-rust red oxide paint, with the necessary instructions indicated in approved colours.

The Contractor shall furnish samples of cable marker for approval of Engineer before installation. The marker shall be welded to an angle iron fixed to the ground on a cement concrete base or as directed by the Engineer. The earth continuity conductor shall be laid in the trench

with the cables. The Contractor shall submit to the Engineer for approval, schedule of cable markers showing location of marker and instructions on each.

The cable trench shall be excavated as per route and location shown on the Drawing. Before laying of cables in the trench, the bed of the trench shall be leveled and filled with a four inch thick layer of fine sand (1/32 inch diameter maximum particles size). The sand layer shall be leveled and the cables placed thereon, the cables shall be covered with a layer of fine sand four inch thick measured above the top of the largest cable.

The cable protective bricks placed above the top of sand cover shall be of Class - C cement concrete, minimum two inch thick and 12 inches x 12 inches square or as approved by the Engineer. The bricks shall be placed over the sand layer end to end to cover the entire length and breadth of the cable trench. After the concrete bricks are placed, the remainder of the trench shall be backfilled with earth in layer 16 inches thick. Each layer shall be thoroughly tamped and compacted.

Sufficient slack shall be left in cables for which purpose the cut lengths of cables shall be about 3% more in the measured lengths between terminations. At underground joint box, ample slack shall be left to prevent straining of cable joints due to settlement of the cable trench.

The cut lengths of cables wherever stated are only as a guide. The Contractor shall measure actual lengths between terminations of each circuit and if the discrepancy between measured lengths at site and where given on the Drawing differ by more than $\pm 10\%$, the Contractor shall report to Engineer and act as directed. Cables, whether installed underground or in cement concrete trenches shall not be bent to a radius less than that recommended by the cable manufacturers.

5. MEASUREMENT AND PAYMENT

5.01 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

5.02 Light Circuit Wiring

5.02.1 Measurement

Measurement shall be made for the total number of light circuit wiring from LV distribution board/LV switchboard to point/switch including wiring between switches on same circuit, acceptably carried out by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing, connection, testing, commissioning and completion of the circuit wiring from the LV switchboard/LV distribution board to point/switch including wiring between switches on same circuit complete with conduit, wire/cable, earth continuity conductor, accessories etc.

5.03 Light/Fan Point/Point to Point Wiring

5.03.1 Measurement

Measurement shall be made for each light point, wiring between the light point and switch, point to point, acceptably carried out by the Contractor as a complete unit.

5.03.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the wiring between light point to switch and point to point including required size of cable, conduit, earth continuity conductor, flexible cable, ceiling rose, accessories etc.

5.04 Wiring of Lights Directly Controlled from Distribution Board/Local MCBs/Wiring of Push Buttons

5.04.1 Measurement

Measurement shall be made for wiring of each light point directly controlled from distribution board or local MCBs type switch and wiring of push buttons acceptably carried out by the Contractor as a complete unit.

5.04.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, testing and commissioning of wiring of light points directly controlled from distribution boards or local MCB type switches and wiring of push buttons including required size of wire, conduit, earth continuity conductor, flexible cable, ceiling rose, accessories etc.

5.05 Wiring of 5 Amps, 250 Volt Combined 2 & 3 Pin Switched Socket

Unit from LV Switchboard/Distribution Board**5.05.1 Measurement**

Measurement shall be made for number of points for wiring of 5 Amps, 250 Volt, combined 2 & 3 pin switched socket unit acceptably carried out by the Contractor as a complete unit.

5.05.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring for 5 Amps 250 Volt, combined 2 & 3 pin switched socket unit from LV switchboard/distribution board including specified size of single core PVC cables including conduit, ECC, PVC conduit, accessories etc. complete in all respects.

5.06 Wiring between 5 Amps, 250 Volt Combined 2 & 3 Pin Switched Socket Units**5.06.1 Measurement**

Measurement shall be made for number of points for wiring between 5 Amps, 250 Volt, combined 2 & 3 pin switched socket unit acceptably carried out by the Contractor as a complete unit.

5.06.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring between 5 Amps 250 Volts, combined 2 & 3 pin switched socket unit including specified size of single core PVC cables including conduit, ECC, PVC conduit, accessories etc. complete in all respects.

5.07 Wiring of 15 Amps, 250 Volt 3 Pin Switched Socket Unit from LV Switchboard/Distribution Board/Bus Bars**5.07.1 Measurement**

Measurement shall be made for number of points for wiring of 15 Amps, 250 Volt, 3 pin switched socket unit acceptably carried out by the Contractor as a complete unit.

5.07.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring for 15 Amps 250 Volt, 3 pin switched socket unit from LV switchboard/distribution board/Bus Bars including specified size of single core PVC cables including conduit, ECC, PVC conduit, accessories etc. complete in all respects.

5.08 Wiring between 15 Amps, 250 Volt 3 Pin Switched Socket Units

5.08.1 Measurement

Measurement shall be made for number of points for wiring between 15 Amps, 250 Volt, 3 pin switched socket unit acceptably carried out by the Contractor as a complete unit.

5.08.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring between 15 Amps 250 Volt, 3 pin switched socket units including specified size of single core PVC cables including conduit, ECC, PVC conduit, accessories etc. complete in all respects.

5.09 Wiring of 20 Amps, 250 Volt 3 Pin Switched Socket Unit from LV Switchboard/Distribution Board

5.09.1 Measurement

Measurement shall be made for number of points for wiring of 20 Amps, 250 Volt, 3 pin switched socket unit acceptably carried out by the Contractor as a complete unit.

5.09.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the contract unit price each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring for 20 Amps 250 Volt, 3 pin switched socket unit from LV switchboard/ distribution board including specified size of single core PVC cables including conduit, ECC, PVC conduit, accessories etc. complete in all respects.

5.10 LV Cables

5.10.1 Measurement

Measurement shall be made for the number of running metre for each size and type of LV cable acceptably supplied and installed by the Contractor.

5.10.2 Payment

Payment shall be made for the number of running metre of each size of cable measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of the LV cables including all accessories.

5.11 Excavation of Cable Trench

5.11.1 Measurement

Measurement shall be made for the number of cubic metre for excavation of each size of cable trench acceptably carried out by the Contractor.

5.11.2 Payment

Payment shall be made for the number of cubic metre of excavation for each size of cable trench measured, as provided above, at the Contract unit price each and shall constitute full compensation for excavation of the LV cable trench in ordinary soil and slightly rocky site.

5.12 Backfilling of Cable Trench

5.12.1 Measurement

Measurement shall be made for the number of cubic metre of backfilling for each size of cable trench acceptably carried out by the Contractor.

5.12.2 Payment

Payment shall be made for the numbers of cubic metre of backfilling for each size of cable trench measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for four-inch thick sand bed, four inch thick sand cover, cable protective tiles/bricks, backfilling of already excavated earth, watering, compaction, consolidating etc. complete to the satisfaction of the Engineer.

SECTION - 6 MEDIUM VOLTAGE (MV) CABLE

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of Medium Voltage (15KV) cables and the accessories as specified herein or as shown on the Tender Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the electrical lines.

The MV cables with accessories shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Tender Document and latest WAPDA Specifications.

2.0 GENERAL

The cable shall be suitable for nominal service voltage of 11 kV, have copper conductor and be cross-linked polyethylene (XLPE), insulated, shielded, armoured and sheathed. It shall be suitable for indoor and outdoor use in the transmission and distribution of electrical energy.

3.0 APPLICABLE STANDARD/CODES

Latest editions of the following standards and codes shall be applicable for the materials within the scope of this Section:

- | | | |
|---------|---|---|
| IEC 183 | - | Guide to the selection of HV cables. |
| IEC 502 | - | Extruded solid electric insulated power cable for rated voltage from 1kV to 30 kV |
| IEC 540 | - | Test methods for insulation and sheaths of electrical cables and cords. |

4.0 MATERIAL

4.1 MV Cable

The cable shall meet the following specifications:

Nominal/System Voltage - 11 KV

Frequency	-	50 HZ
System	-	3 phase
Conductor Size	-	Given in BOQ
Number of Cores	-	3 numbers
Rated Voltage	-	15 KV phase to phase 8.76 KV phase to ground
Continuous Operating Temperature of conductor	-	90 degrees Celsius
Conductor material	-	Copper stranded
Insulation	-	Cross-linked polyethylene
Shielding	-	Copper tape
Jacket	-	PVC
Armoring	-	Galvanized wire
Oversheathing	-	Extruded PVC
Phase identification	-	Red, Yellow, Blue

4.1.1 Conductor Material

The conductors shall be of high conductivity electrolytic copper stranded in accordance with specified standard.

4.1.2 Insulation

The insulation shall be cross-linked polyethylene extruded over the conductor. The insulation shall be laid to avoid any gap/air pockets between the conductor and insulation.

The insulation shall be easy to strip from individual conductors and to separate for jointing/termination purposes.

4.1.3 Shielding

A layer of semi-conducting material applied directly over the insulation shall shield each core. A bare copper tape applied with suitable overlapping shall cover the semi-conducting insulation.

Phase identification tape of red, yellow, and blue colour shall be wrapped over the copper shield.

4.1.4 Assembly

The three insulated conductors shall be assembled with PVC or any non-hygroscopic filler and bound with tape. The tape binder shall then be covered with extruded PVC jacket. The PVC jacket shall be padded with a suitable material before application of armour.

4.1.5 Armour

Armoring shall be provided with single layer of galvanized steel wire to provide cable protection and also act as a low resistance earth return path. The armoring shall be covered with binder tape. The armour shall be of appropriate size to carry the system fault current.

4.1.6 Oversheath

The entire cable assembly shall be covered with a PVC jacket of thickness not less than 2.5mm. The colour of the jacket shall be black. In addition to any other marking proposed by manufacturer, the size of cable and voltage grade shall be given on the oversheath at every 3 meters interval.

4.2 Cable Reels

The cable shall be supplied in non-returnable, mechanically strong, sea/rail/road worthy, wooden or metallic cable drums, protected against weather. The cable drum should bear the markings for cable type, cable size, voltage grade, year of manufacture, name of manufacturer, direction of unreeling and any other additional marking normally provided by the manufacturer. Cable ends on cable reels shall be protected by means of suitable seal.

4.3 Factory Tests

Physical and electrical acceptance tests in accordance with applicable standard shall be carried out at the manufacturer works. Three copies of test reports will be furnished to the Engineer, which shall include brief description of tests, test records and results.

5.0 INSTALLATION

5.1 General

The Contractor shall furnish all installation material, labour, tools and accessories for cable installation. The cable and accessories shall be installed as described in accordance with the installation instructions given in the Section for Low Voltage Cable of these Specifications, drawings and in accordance with manufacturer's instructions. Prior to installation of jointing and termination kits, the cable lengths shall be checked and tested to ensure that the cables are in sound condition and no damage has been done during handling and installation. After the MV cable and jointing/termination kits are installed, it shall again be tested prior to commissioning and in accordance with recommendations of standard to which the cable is manufactured.

The Contractor shall confirm exact cut lengths for the cable by actual measurements at site prior to the commencement of manufacturing. The cable lengths where shown on the drawing are tentative and only for general guidance. The Contractor shall be solely responsible for furnishing correct lengths of cable to avoid joints in cable length except where necessary, after obtaining approval of the Engineer.

5.2 Underground Cables

The cables to be installed directly underground shall be laid in trenches in single tiers. Unless that shown specifically on the drawing the depth of cable below finished ground level shall be 900-mm minimum measured from the top of the largest cable to the general ground level. The burial depth may be increased as required due to site conditions or when crossing other service pipes and roads. Burial depth less than 900mm and more than 1500mm shall require Engineer's approval.

When cables cross road, paved area, other services or other cables, they shall be laid in protective pipes of required size. Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of bituminised resin or equivalent method as approved by the Engineer. A minimum clearance of 250mm vertically and 500mm horizontally shall be maintained between cables and other services.

The cable trench shall be excavated as per route and location shown on the drawing. Before laying of cables in the trench, the bed of the trench shall be leveled and filled with a 75mm thick layer of fine sand (1.3mm diameter maximum particles size). The sand layer shall be leveled and the cables placed thereon. The cables shall be covered with a layer of fine sand 75mm thick measured above the top of the largest cable. The cable protective bricks placed above the top of sand cover shall be of class-A cement concrete, minimum 50mm thick and 300mm square. The bricks shall be placed over the sand layer end to end to cover the entire length and breadth of the cable trench. After the concrete bricks are placed, the remainder of the trench shall be backfilled with earth in layer 400mm thick. Each layer shall be thoroughly tamped and compacted.

Cable identification tags of corrosion resistant material shall be tied to cables with bronze wire at a maximum of 20 metre interval along the cable length for identification of cable and circuit. The earth continuity conductor shall be laid in the trench with the cables. The Contractor shall submit to the Engineer for approval, schedule of cable markers showing location of marker and instructions on each.

Sufficient slack shall be left in cables for which purpose the cut lengths of cables shall allow about 3% more in the measured lengths between terminations. At underground joint box, ample slack shall be left to prevent straining of cable joints due to settlement of the cable trench. The cut lengths of cables wherever stated are only as a guide. The Contractor shall measure lengths between terminations of each circuit and if the discrepancy between measured lengths at site and where given on the drawing differ by more than 5%, the Contractor shall report to Engineer and act as directed. Cables, whether installed underground, or in cement concrete trenches, shall not be bent to a radius less than that recommended by the cable manufacturers.

5.3 Cable Marker

Above ground, cable markers shall be erected at 30 metre intervals along the straight trench, and at each bend and joint box for indication of presence of underground cable. For more than one metre wide trenches, cable markers shall be provided at both edges of the trench. The cable marker shall bear the necessary instructions indicated in approved colours. The Contractor shall furnish samples of cable marker for approval of Engineer before installation. The marker shall be welded to 50x50x4 mm angle iron fixed to the ground on a cement concrete base or as directed by the Engineer.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

6.2 MV Cable

6.2.1 Measurement

Measurement shall be made for the total number of running meters or running feet of MV cable acceptably supplied and installed by the Contractor and which has satisfactorily passed all the required tests prior to and after installation.

6.2.2 Payment

Payment shall be made for the total number of running meters or running feet of the MV cable, as provided above, at the Contract unit price and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of the MV cable including all accessories.

6.3 Excavation of Cable Trench

6.3.1 Measurement

Measurement shall be made for the number of cubic feet or cubic meters for excavation of each size of cable trench acceptably carried out by the Contractor.

6.3.2 Payment

Payment shall be made for the number of cubic feet or cubic meters of excavation for each size of cable trench measured, as provided above, at the Contract unit price each and shall constitute full compensation for excavation of the cable trench in ordinary soil & slightly rocky site.

6.4 Backfilling of Cable Trench

6.4.1 Measurement

Measurement shall be made for the number of cubic feet or cubic meters of backfilling for each size of cable trench acceptably carried out by the Contractor.

6.4.2 Payment

Payment shall be made for the number of cubic feet or cubic meters of backfilling for each size of cable trench measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for four-inch thick sand bed, four inch thick sand cover, cable protective tiles/ bricks, backfilling of already excavated earth, watering, compaction, consolidating, etc. complete to the satisfaction of the Engineer.

6.5 Cable Marker

6.5.1 Measurement

Measurement shall be made for the number of each size and type of cable markers acceptably supplied and installed by the Contractor as a complete unit.

6.5.2 Payment

Payment shall be measured for the number of units measured as above at the Contract price each and shall constitute full compensation for the supplying and installation of cable markers.

SECTION – 7

MEDIUM VOLTAGE (MV) CABLE TERMINATION KITS

1.0 SCOPE OF WORK

The work under this section consists of supplying of Medium Voltage (MV) cable Termination Kits as specified herein and given in the Bill of Quantities.

2.0 GENERAL

The MV cable termination kits shall be suitable for MV 8.76/15 kV, XLPE copper conductors cables. It shall be suitable for indoor, outdoor and underground installations.

3.0 APPLICABLE STANDARD/CODES

The Latest editions of the relevant standards and codes shall be applicable for the materials within the scope of this Section.

4.0 MATERIAL

4.1 Termination Kits for 8.76/15 kV MV Cables

The termination kits shall be suitable for indoor, outdoor and underground installations. The termination kits shall be complete with all materials.

The MV termination kits shall be from special Silicon skirted or tubular EPDM rubbers.

The tubes shall be pre-stretched to avoid the use of torches or external heat sources.

The MV termination kits shall be supplied complete with stress control tape with a di-electric constant of 30 minimum.

The MV termination kits shall be supplied with all required mounting, installation and operational accessories.

4.2 Straight - Through Joint

The joint-boxes for the cable shall be suitable for indoor or outdoor installation in accordance with the system requirements.

The joint boxes shall be horizontal, straight through, split type. Where installed underground, these shall be suitably protected against corrosion and ingress of moisture. At least two venting holes with plugs shall be provided for compound filling and inspection. Ground straps shall be furnished on the inside of joint box for ground continuity of the cable armour.

4.3 Factory Tests

Physical and electrical acceptance tests in accordance with applicable standard shall be carried out at the manufacturer works. Three copies of test reports will be furnished to the Owner, which shall include brief description of tests, test records and results.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

6.3 MV Termination Kit and Straight through Joints

6.3.1 Measurement

Measurement shall be made for each type of MV termination kit/straight through joint acceptably supplied by the manufacturer/supplier as a complete unit.

6.3.2 Payment

Payment shall be made for the number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying of MV termination kits/straight through joints including all installation accessories, support for joint as required.

SECTION 8

SPECIFICATIONS OF LED LIGHTS

1.0 SCOPE OF WORK

The work under this section consists of manufacturing, fabricating, supplying, installing, earthing, testing and commissioning of all material with accessories and services for the complete LED fixtures as specified herein and as shown on the drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact locations and positions of the LED fixtures.

The light fixtures with accessories shall also comply with the General Specifications as applicable for Electric Works section-8001 and with other relevant provisions of the Documents.

1.1 Type of Light Fixtures

A. Down Lighters

LED based down lighters should be suitable for all indoor applications with different mounting provision of recessed & surface.

The total lumens offered by the composite fixture shall be in the range of (900-1000) lm for 10 W fixtures ($\pm 2W$) and (1900-2000) lm for 20W ($\pm 2W$) fixtures with efficacy greater than 95 lm/W. The power factor of the fixture shall be minimum 0.9 with Color rendering greater than 80. Luminaire should have color temperature options (3000K, 4000K, 6500K) as per application requirements. The total life time span offered by the fixture shall be 45000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards pertaining to EMC and Photo biological safety. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP20. The housing of the fixture shall be preferably with die cast aluminum. Proper heat dissipation arrangement shall also be ensured. Complete Test reports complying with applicable standards shall also be furnished as applicable.

B. Batten Lights

LED Batten light should be suitable for all indoor applications with mounting provision of surface. The total lumens offered by the composite fixture as minimum shall be in the range of (800-1000) lm for 8-10 W fixtures ($\pm 2W$) and

(1600-2000) lm for 16-20W fixtures ($\pm 2W$) respectively with the efficacy greater than 95 lm/W. The power factor of the fixture shall be minimum 0.8 with Color rendering greater than 70. Luminaire should have color temperature options (3000K, 4000K, 6500K) as per application requirements. The total life time span offered by the fixture shall be 30000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP20.

C. Bulk Head

LED Bulk Head light should be suitable for all semi indoor and outdoor applications with mounting provision of surface. The total lumens offered by the complete fixture shall be in the range of (1600-2500) lm for 20-30 W fixture range ($\pm 3W$) with the efficacy of more than 80 lm/W. The power factor of the fixture shall be minimum 0.85 with Color rendering index of 80. Luminaire should have color temperature options (3000K, 4000K, 6500K) as per applications requirements. The total life time span offered by the fixture shall be 35000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP 54 for semi indoor and IP 65 for outdoor installation with impact resistance (IK) above 6. The housing of the fixture shall be preferably die cast aluminum with PC front cover.

D. In Ground Recessed Lights for Façade lighting

LED Inground recessed lights shall be suitable for uplight and wall washer effect applications for building façade with mounting provision of recessed type. The total lumens offered by the complete fixture shall be greater than 1500 lm for 18 W fixture ($\pm 5 W$) with the efficacy greater than 85 lm/W. The power factor of the fixture shall be minimum 0.9 with Color rendering index of 80. Luminaire should have color temperature options (3000K, 4000K, 6500K) with different beam angles of 20°, 30°, 45° as per applications requirements. The total life time span offered by the fixture shall be 35000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP 67 with impact resistance (IK) above 6. The housing of the fixture shall be preferably die cast aluminum with proper recessed box for installation in ground with provision of surge protection if required.

E. Flood Lights for Façade, Parking Sheds and Landscape lighting

Floods lights shall be suitable for uplight and wall washer effect applications for

building façade, may also be used under parking sheds and for landscape lighting with required mounting provision. The total lumens offered by the complete fixture shall be greater than 2500 lm for 30 W fixtures ($\pm 5W$) with the efficacy of around 85 lm/W. The power factor of the fixture shall be minimum 0.9 with Color rendering index of more than 70. Luminaire should have color temperature options (3000K, 4000K, 6500K) with different beam angles as per applications requirements. The total life time span offered by the fixture shall be 35000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP 65 with impact resistance (IK) above 6. The housing of the fixture shall be preferably die cast aluminum with proper heat dissipation and surge protection arrangement.

F. Post top Lights For Decorative Lighting

LED Post top lights shall be suitable for mounting on poles of height (3m-5m) for area decorative lighting. The total lumens offered by the complete fixture shall be 2500 lm minimum for 30 W fixtures ($\pm 5W$) with the efficacy of around 85 lm/W. The power factor of the fixture shall be minimum 0.9 with Color rendering index of more than 70. Luminaire should have color temperature options (3000K, 4000K, 6500K) as per applications requirements. The total life time span offered by the fixture shall be 35000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP 65 with impact resistance (IK) above 6. The housing of the fixture shall be preferably die cast aluminum with proper heat dissipation and surge protection arrangement.

G. Planter/Spot Lights

LED Planter/Spot lights shall be suitable for landscape and green areas lighting with suitable surface mounting and spiker in earth arrangement. The total lumens offered by the complete fixture shall be greater than 500 lm for 8-15 W fixtures ($\pm 2W$). The power factor of the fixture shall be minimum 0.8 with Color rendering index of more than 70. Luminaire should have color temperature options (3000K, 4000K, 6500K) as per applications requirements. The total life time span offered by the fixture shall be 25000 hours @L70 (tolerance $\pm 5,000$ hours) Overall luminaire system efficiency should be more than 80%. Luminaire should comply with IEC standard 60598 and relevant applicable standards. Earthing provision should be given inside the luminaries and the ingress protection of the fixture shall be at least IP 65 with impact resistance (IK) 6 or above. The housing of the fixture shall be preferably die cast aluminum with tempered glass and proper heat dissipation arrangement.

H. Bollard Lights

LED Bollard lights shall be suitable for area lighting with height of 0.5-0.8m and aluminum body. The total lumens offered by the complete fixture shall be greater than 700 lm for 9-15 W fixture ($\pm 2W$). The lifetime shall be 40,000 hours (tolerance $\pm 5,000$ hours). Color rendering index shall be more than 80. Standard Fixture power factor shall not be less than 0.90.

Fixture shall have different color temperature options ranging from 3000K to 4000K as per application requirements. System efficiency shall be more than 70%. The fixture shall have ingress protection (IP) of IP-65 or above and Impact Resistance (IK) 06 or above. It shall comply with EN 60598 and any other international standards as applicable.

1.2 Optics

The fixtures for above referred lighting shall have flexible optical systems for the wattage range in the respective group.

The fixture shall use high efficiency LED and optics system.

The Light Output Ratio (LOR) shall not be less than 90%.

The multilayer optics design shall ensure adequate luminance and illuminance uniformity in the unlikely event of an individual LED failure.

The fixture shall offer choice of different beam light distribution as required for particular fixture

The optical lens system shall feature long life with no discoloration (UV protection), highest possible light transmission and white painted circuit board for high reflectivity for maximum light output.

1.3 Warranty/Maintenance

The LED manufacturer /authorized agent/assembler shall not only be responsible for 5 years of warranty but also during the warranty period maintenance of the fixtures including free of cost replacements of any/all defective components/parts against manufacturing defects with the genuine products/components through the manufacturer/authorized agents under the supervision of the contractor/maintenance agency.

The involvement of the manufacturer/authorized agent for maintenance/replacement of components is considered important because the warranty of the manufacturer becomes void if genuine product/manufacture recommended methodology/components installation is not followed. In addition to this it is also

necessary that genuine branded products those offered at the time of supply with the fixtures are provided for the 5 years of warranty / component replacement period.

Undertaking in this regard shall be submitted by the contractor as well as manufacturer/authorized agent/assembler to the Client.

Further, if required, the manufacturer/authorized agent/assembler through contractor shall provide the proof of genuineness from the manufacturer for various components provided/installed in the fixtures after fulfilling the technical requirements

1.4 LED Driver/Electronic Control Gear for LED Modules

The LED driver shall be designed to operate luminaries LED with current controlled output through Class I electrical classification. The driver shall be suitable for nominal 230V, +10%, -15%, 50Hz mains supply. The LED driver shall have an efficiency of at least 85%. The test reports showing compliance with applicable standards shall be submitted by the manufacturer.

1.5 LED Chip

The LED chip shall be Philips Lumiled, Cree, Nichia, Osram, Samsung, LG, ETI, & seoul semiconductor make or equivalent in performance (duly tested as specified and in full conformance to the technical requirements/specifications) as specified.

The LEDs shall:

- be designed for lumen maintenance of L₇₀ or 70% at the end of useful life at ambient temperature of 35 deg C.
- have a useful life burning hours as specified for relevant fixture
- have a color rendering index (Ra) of 80 (+10/-10) and a color temperature 2700K-6500K as per application requirements
- have a color consistency within 5 SDCM (standard deviation of color matching) as defined by MacAdam.
- LM 80 Report with TM21 extrapolation graph must be attached.

1.6 Thermal Management

Managing thermal properties in LED fixtures is most critical to ensure optimum performance of LEDs and reliability of the system.

The housing under the circuit board shall be specially designed to ensure perfect contact between the board and the fixture housing for efficient heat dissipation.

PCBs shall be used to maximize heat transfer process and to offer reinforced electrical insulation via dielectric layer. The PCB shall be mounted on the housing using a highly efficient thermal interface material. Use of Silicon glue is not acceptable.

The housing over the driver chamber shall have ribs or any other mechanism with adequate surface area to ensure fast heat dissipation.

1.7 Photometrics

Fixtures shall have Illumination Engineering Society (IES) files of different distribution patterns.

LM-80 LED and photometric test reports and IES files from a third party testing laboratory shall be available.

1.8 Technical Data and Drawings

Technical and descriptive data and drawings to be submitted shall include but not be limited to the following:

- i) Technical data of fixtures, driver and LEDs
- ii) IES photometric file
- iii) Customer testimonials
- iv) Factory ISO certificate
- v) Reports showing compliance to applicable standards and other type tests stipulated in the respective standards/codes, if any applicable

2.0 INSTALLATION

The installation of LED light fixtures shall be in strict accordance with the manufacturer's instructions/recommendations and these specifications.

3.0 MEASUREMENT AND PAYMENT

i) General

The Contractor's bid amount against each bill of quantities item as given shall include supply, installation, testing, commissioning and completion of all work specified herein and/or shown on the Drawings related to the LED light fixture.

ii) Measurement

Measurement shall be made as complete job for all related equipment such as power supply, driver etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

iii) Payment

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying installing, testing and commissioning along with all accessories.

TECHNICAL SPECIFICATIONS LED PANEL LIGHT

Product: LED Panel light fixture for wattage 40W (± 10 W) recessed/suspended/surface mounted

Specifications:

The LED light fixture (Panel type) should be recessed/suspended/surface mounted and have capability deliver energy efficiency without sacrificing light quality in general lighting applications.

The composite system efficacy of the light fixture should at least 95 lm/W.

The power factor of the composite fixture shall be minimum 0.90

Luminaire must provide minimum 50% energy-saving compared with conventional Fluorescent light fixture. The system lumens output of the light fixture should not be less than 3500 lumens.

The Color Rendering Index of the fixture should be greater than 80 and the color temperature of the light fixture shall be available in different options (3000K, 4000K, 6500K) as per application requirements

The ambient temp for the light fixture is $-2^{\circ}\text{C} < T_a < 40^{\circ}\text{C}$.

Housing:

The housing will include integrated heat sink and optical system. The housing will be made of Plastic frame in white color, & the heat sink will make of aluminium for better heat transfer.

Optics

The fixtures for above referred lighting shall have flexible optical systems for the wattage range in the respective group.

The fixture shall use high efficiency LED and optics system.

The Light Output Ratio (LOR) shall not be less than 90%.

The multilayer optics design shall ensure adequate illumination uniformity in the unlikely event of an individual LED failure.

The optical lens system shall feature long life with no discoloration (UV protection), highest possible light transmission and white painted circuit board for high reflectivity for maximum light output.

Mounting Type

The luminaire shall have provision of Recessed, Suspended and surface mounting with sizes as per project specified requirements Suspension kit for suspended and box arrangement for surface mounted version must be available

LED Driver/Electronic Control Gear Specification

The LED driver shall be designed to operate large array of high powered LEDs through current controlled output through Class I electrical classification. The driver shall be suitable for 230V, +10%, -15%, 50Hz, single phase mains AC supply.

The LED driver shall have an efficiency of at least 85%.

The LED driver shall be of Harvard, TCI, Philips, VOSSLOH Schwabe, GE, Tridonic, meanwell, Pierlite, NVC, Make or equivalent (duly type tested as specified and in full conformance to the technical requirements/specifications).

LED:

The LED chip shall be Philips Lumiled, Cree, Nichia, Osram, Samsung, LG, ETI, seoul semiconductor make or equivalent in performance. (duly tested as specified and in full conformance to the technical requirements/specifications) as specified.

The LEDs shall:

- Be designed for lumen maintenance of L70 or 70% at the end of useful life
- Have a useful life of 50,000 burning hours.
- Have a minimum color rendering index (Ra) of 80 (+10/-10) and a color temperature above 5000K.
- Have a color consistency within 5 SDCM (standard deviation of color matching) as defined by MacAdam.
- LM 80 Report with TM21 extrapolation graph must be attached.

Thermal Management

Managing thermal properties in LED fixtures is most critical to ensure optimum performance of LEDs and reliability of the system.

The housing under the circuit board shall be specially designed to ensure perfect contact between the board and the fixture housing for efficient heat dissipation.

PCBs shall be used to maximize heat transfer process and to offer reinforced electric insulation via dielectric layer. The PCB shall be mounted on the housing using a high efficient thermal interface material. Use of Silicon glue is not acceptable. The housing of the driver chamber shall have ribs or any other mechanism with adequate surface area ensure fast heat dissipation.

1.7 Photometrics

Fixtures shall have Illumination Engineering Society (IES) files of different distribution patterns.

LM-80 LED and photometric test reports and IES files from a third party test laboratory shall be available.

Applicable Standards and Codes

The luminaire should fully conform to the following standards (the supplier/contractors shall furnish the detailed type test reports for the luminaires being offered to establish conformance to the specified requirements) :

1. IEC 60598-1
2. IEC 60598-2-2– Electrical Insulation Class I
3. IEC62031: LED modules for general lighting – Safety specifications
4. LM-79
5. LM 80 Report with TM21 extrapolation graph must be attached.
6. IES Photometry file

The LED Driver/fixture should fully conform to the following standards (the supplier/contractors shall furnish the detailed type test reports for the luminaires being offered to establish conformance to the specified requirements) :

1. EN 55015 : 2013 – Emission – Electrical lighting and similar equipment
2. EN 61547: 2009 – Immunity – Equipment for general lighting purpose
3. EN 61000-3-2 : 2009 – Limits for harmonic currents emissions.
4. EN 61000-3-3 : 2008 – Limits for voltage fluctuation and flicker.
5. IEC62471 2008 :Photo biological safety of lamps and lamps systems
6. EN 62493 Assessment of lighting equipment related to human exposure to electromagnetic fields

All test reports and certificates must be from third party accredited laboratory.

Warranties

The LED manufacturer /authorized agent/assembler shall not only be responsible for 5 years of warranty but also during the warranty period maintenance of the fixtures including free of cost replacements of any/all defective components/parts against manufacturing defects with the genuine products/components through the manufacturer/authorized agents under the supervision of the contractor/maintenance agency.

The involvement of the manufacturer/authorized agent for maintenance/replacement of components is considered important because the warranty of the manufacturer becomes void if genuine product/manufacture recommended methodology/components installation is not followed. In addition to this it is also necessary that genuine branded products those offered at the time of supply with the fixtures are provided for the 5 years of warranty / component replacement period.

Undertaking in this regard shall be submitted by the contractor as well as manufacturer/authorized agent/assembler to the Client.

Further, if required, the manufacturer/authorized agent/assembler through contractor shall provide the proof of genuineness from the manufacturer for various components provided/installed in the fixtures after fulfilling the technical requirements

Technical and Descriptive Data and Drawings

Technical and descriptive data and drawings to be submitted shall include but not be limited to the following:

- Technical data of fixtures, LEDs and driver
- IES photometric file
- All detailed type test reports to establish conformance to specified international codes and standards as stipulated above.
- LM-80 test report of LED used
- 3rd Party IEC 60598 test reports specific to the fixtures being offered.
- EMC test report
- Photo- biological safety test report
- Customer testimonials
- Factory ISO certificate
- Reports of other type tests stipulated in the respective standards/codes

International Independent Laboratories

For the specified requirements of type tests and type test reports by an independent authority/independent laboratory (specific to their status/approval for performance of specific test(s) on the fixtures as defined in the project), the following laboratories shall be considered as independent laboratories:

- KEMA Labs, Holland.
- CESI Labs, Italy.
- CRIEPI Labs, Japan.

- Any other laboratory accredited by EA (European Co-Operation for Accreditation) or a member thereof.
- Any other laboratory accredited by ILAC (International Laboratory Accreditation Cooperation) or a member thereof.
- Any other laboratory accredited by IAF (International Accreditation Forum) or a member thereof.
- Any other laboratory accredited by STL (Short-Circuit Testing Liaison) or a member thereof.

INSTALLATION

The installation of LED light fixtures shall be in strict accordance with the manufacturer's instructions/recommendations and these specifications.

MEASUREMENT AND PAYMENT

General

The Contractor's bid amount against each bill of quantities item as given shall include supply, installation, testing, commissioning and completion of all work specified herein and/or shown on the Drawings related to the LED light fixture.

Measurement

Measurement shall be made as complete job for all related equipment such as power supply, driver etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

Payment

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying installing, testing and commissioning along with all accessories.

SECTION – 10

ELECTRICAL WORKS

1.1 DESCRIPTION

The work under this Contract consists of supplying, storage at site, installing, testing and commissioning of all materials and services comprising poles, lighting fixtures, lighting control panels, distribution transformers, cables, earthing, conduits and pipes etc., as specified herein, shown on the Drawings and given in the Bill of Quantities. Small items which are not expressly specified but which are necessary for completion of work shall be supplied by the Contractor without extra cost. The supply connection for lights etc. shall be obtained from the nearby WAPDA source. The work shall be complete in every respect for satisfactory operation as per specifications and standards give hereinafter.

The Contractor shall co-ordinate with the Engineer at site with respect to other services for exact location and position of all electrical equipments.

1.2 GENERAL

The location of the lighting fittings, poles, distribution boards, lighting control panels, distribution transformers and cables etc. are tentatively shown on the drawings. The Contractor shall ensure the exact position and location of poles and cable routes etc. in coordination with other services as per site requirement. The Contractor shall be responsible for proper light distribution on the road/underpass surface from the proposed luminaires and other equipment after installation and commissioning. He shall be fully responsible during maintenance period of the works.

The road/underpass lighting work shall be installed as per requirements of BS-5489 or other similar international standards. The Contractor shall also comply with the regulations of Pakistan Electricity Act and requirements of Water and Power Development Authority (WAPDA), wherever applicable.

The quality of equipment shall be of the best grade for each type, even though such quality may not be stated specifically in the specifications. All materials and products shall be new and manufactured by well known firms. Furthermore, these shall be sound and uniform in quality, size, shape, colour and texture and free from cracks, wrapage or other defects.

Component parts of each electrical system or piece of equipment shall be the latest standard product of a single manufacturer unless otherwise specified and provided sub-components, manufactured by different manufacturers are of specified standards design and dimensions and interchangeability is possible and shall normally have been satisfactory in service for at least two years.

The design criteria for road lighting are based on the following parameters;

Luminance (L) cd/m ²	1~1.5 cd/m ²
Overall Uniformity (U _o) (U _o = L min./L avg.)	0.4
Uniformity of Each lane (U _l) (U _l = L min./L max.)	0.5 – 0.7
Threshold increment not exceeding	≤ 10

Road surface characteristics as per IEC classification is type R2 with q_o = 0.07.

The contractor shall be responsible and confirm in writing that his selection of equipment will ensure on the road surfaces luminance level and uniformities equal or better than those defined in the lighting design criteria.

Within six (6) weeks after award of the contract, the contractor shall submit the technical details of the luminaries and other equipment and having obtained conditional approval thereof submit in duplicate, full detail of the calculated results for the level and uniformity of luminance and illumination on all road surface. These detail should be submitted in the format as described in the relevant IEC publication and after initial approval by the engineer.

1.3 APPLICABLE REGULATIONS AND STANDARDS/CODES

The latest edition of the following standards & codes shall be applicable for the materials within the scope of this work.

IEC	-	International Electro-technical Commission
IEEE	-	Institute of Electrical and Electronics Engineers U.S.A. (IEEE Wiring Regulation UK).
BSS	-	British Standard Specifications
VDE	-	Verband Deutscher Electro-technical (Association of German Electrical Engineers)
NEMA	-	National Electrical Manufacturers Association, U.S.A.

- PSI - Pakistan Standards Institution
- CIE - Commission Electro-technique International

1.4 TESTING

1.4.1 Factory Tests

a. General

All type and routine tests on switchgear and all other equipment shall be performed at the manufacturer's works in the presence of the Engineer or his representative. Type tests may be waived off in case test certificates as certified by an approved standard laboratory of international repute are provided by the Contractor and approved by the Engineer. Submission or merely producing the type test certificates shall not relieve the Contractor to carry out the required standard/routine tests.

The Contractor shall arrange at his own cost factory visit(s) for pre-shipment inspection/testing for all major electrical equipment offered. Airfare to and from inspector's home town (two persons), boarding, lodging and transport shall be Contractor's responsibility and all costs in this respect shall also be borne by the contractor.

In addition, for all pre-shipment inspections carried abroad, the Contractor shall provide (for two persons) daily allowance @ 200 US\$ per day for out of pocket expenses, at per diem rate per person currently recommended by Chamber of Commerce and Industry for foreign travelers on business visa. The number of days shall be actual days spent in travel from and to the home town of the concerned inspector but not less than five (5) days. The 200 US\$ per day per person in cash shall be provided before start of travel from hometown.

For all pre-shipment inspections carried out within Pakistan, the Contractor shall provide (for two persons) daily allowance of Rs. 2,000 for out of pocket expenses, at per diem rate per person. The amount shall be provided in cash before start of travel from hometown for the entire duration of the visit.

The Contractor shall inform the Engineer about the date and time of test of each equipment at least two weeks in advance. The witnessing of test by the Engineer or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment, and for furnishing the guarantees. All test results shall be supplied in triplicate.

b. Insulation Resistance Test

Insulation resistance test shall be made on all Electrical equipment by using a meggar of 500 volts for circuits upto 250 volts and 1000 volts for circuits between 250 and 500 volts.

The insulation resistance values of cables, switchgear, etc., shall be as per BSS, IEC and Pakistan Electricity Rules.

1.4.2 Field Tests

a. General

Upon completion of the installation, the Contractor shall perform field tests on all equipment, materials and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with Specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials etc. and all qualified personnel required for the testing, setting and adjustment of all Electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests.

The Contractor shall record all test values of the tests made by him on all equipment. Three (3) copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams etc.

b. Earth Resistance Test

Earth resistance test shall be made by the Contractor on the earthing system, separating and reconnecting each earth connection.

If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The Electrical resistance of the ECC together with the resistance of the earthing leads measured from the connection with earth electrode to any

other position in the complete installation shall not exceed five ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earth electrodes are installed, the earth resistance test of each electrode shall be measured by means of resistance bridge instrument.

c. Switchgear Test

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams furnished by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses disconnect switches, number of interlocks, indicating lights, alarms and remote control devices shall be in accordance with approved manufacturer drawings. Name plates shall be checked for proper designation of equipment served.

SP-2 POLES FOR ROAD LIGHTING

2.1 SCOPE OF WORK

The work under this section consists of designing, manufacturing, supplying, installation testing and commissioning of the street lighting poles and accessories as specified herein, or as shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact location and position of the electrical poles.

The poles with accessories shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Tender Documents.

2.2 APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this Section:

ASTM A36	-	Steel for Pole and Base Plate
ASTM A307	-	Anchor Bolts
BS EN ISO 1461	-	Galvanization
ASTM A123 & A385	-	Galvanization

2.3 CONSTRUCTION OF POLES

The galvanized steel poles shall be of mild steel as shown on drawing from base plate to lantern connection, well proportioned and neatly finished. The height of the pole from the centre line of the spigot for lantern connection to the ground line and out-reach of each arm from the vertical centre line of the pole to the tip of the spigot for lantern attachment shall be as shown on Drawing. Approval of the Engineer shall be obtained before ordering the poles for manufacturing.

The pole (vertical portion) alongwith base plate shall preferably be in one piece. But if manufacturing in one length is not possible, it can be in two or three pieces with force fit lap joint.

The steel poles after fabrication shall be galvanized by hot dip process (inside and outside) as per applicable standards 'Hot Dip Galvanized Coatings on Iron and Steel Articles'. The poles shall be prepared before galvanizing by removing grease, burs and slag etc. so that zinc coating is adherent, dense, smooth, continuous and uniform. The Contractor shall ensure before placing of order that the firm has adequate facility for hot dip galvanizing process as per standard practice. The steel used in the manufacture of poles shall be made by open hearth or electric furnace process.

The straight portion of the pole shall be truly vertical and no deviation more than 100 mm in the entire length shall be accepted.

Other tolerances shall be as follows:

- Outside diameter = +/- 1%
- Wall thickness = +/- 10%
- Overall length of pole = +/- 0.5%
- Weight = - 0.3%
 + not limited.

The pole and the bracket shall be so designed that when subjected to wind at a velocity of 160 km/hour on the full projected area of pole, bracket and the lantern a factor of safety of 3 on minimum tensile strength of the material shall be obtained. In addition, the temporary horizontal deflections at the lantern position shall not exceed 1/40 of the length of the pole above ground at aforementioned wind velocity.

The poles shall have a base compartment, designed to accommodate a loop-in services cutout for 4 core PVC/SWA/PVC cables of given sizes. A 8 mm stainless steel stud complete with nut and washers shall be provided in the base compartment of the pole for earthing purpose.

The edges of the door opening on the pole shall be reinforced with a 10 mm thick M.S. square bar to reinstate the strength of pole at this location. The opening cover shall consist of weather proof hinged door. The door shall be provided with a heavy duty non-rusting lock.

Flag brackets shall be fitted to poles if shown on the drawing and shall be as approved by the Engineer.

2.4 INSTALLATION

Lighting poles shall be handled/transported and erected in such a way so as to avoid any damages. Any damage to pole or galvanizing shall be made good to the satisfaction of the Engineer.

The lighting poles shall be stored clear of soil, ground water or other rust producing materials. The fixing of poles shall be carried out in accordance with manufacturer's instructions and good engineering practice.

The poles shall be erected in a true vertical position.

Where lighting poles are to be installed in the vicinity of overhead power lines, the Contractor shall inform the Engineer and act as directed. He shall maintain clearances as per WAPDA requirements from the power lines.

The Contractor shall number all the poles with high quality paint using stencil for 50 mm high lettering. The numbering shall be at 1200 mm from the bottom of pole towards the road. The numbering shall be in a manner as directed by the Engineer.

Earth backfill around pole foundation shall be done in 150 mm thick layers and shall be well ramed and compacted to provide full lateral support.

2.4.1 Data to be submitted

Before manufacturing, the Contractor shall submit for approval of the Engineer, the shop drawing of the pole anchor bolts, base plate and pole bracket together with details of the base compartment, cover and the means adopted for making it waterproof and tamperproof. Design calculation sheets for the poles from manufacturer shall also be submitted by the contractor to show that poles/foundations are safe for all specified stresses.

2.5 TESTS

2.5.1 General

The poles shall be tested and the results recorded for each test by the manufacturer in the presence of an authorized representative of the Owner or Engineer as stated below.

2.5.2 Inspection

Prior to inspection, checklist shall be submitted pertaining to fabrication of each pole lot duly filled in by the manufacturer.

The material, weight and dimensions of poles as specified shall be certified by the manufacturer. The poles shall be inspected and in case being found below the limits of tolerance as aforementioned, shall be rejected.

2.5.3 Sample Test

Sample of poles shall be selected at random basis from each lot of high masts and poles and shall be checked in accordance with the project specific requirements, BoQ, relevant construction drawings and applicable manufacturing standards. Factory routine test certificates shall be submitted by the manufacturer for each type of high masts/poles.

2.5.4 Galvanizing

Weight, uniformity of coating and other requirements shall be strictly inspected in accordance with applicable standards.

2.5.5 Service Cutouts

Each pole shall be provided with a waterproof and dust tight loop-in-service cutout accommodated in the base compartment of the pole.

The junction box shall comprise two (2) 2A MCB, for double arm poles and one (1) 2A MCB in accordance with IEC 60947 for single arm poles, a solid neutral link and an earthing terminal. It shall incorporate arrangements for looping "IN" and "OUT" for 4 core up to 25 mm² PVC/SWA/PVC cable having copper/aluminium conductor. The earth terminals, nuts and washers shall be adequately sized to take the earth continuity conductors with tight connections.

Dimensional drawings and details of the junction cutout box of pole shall be submitted for approval to the Engineer.

2.6 MEASUREMENT AND PAYMENT

2.6.1 Measurement

Measurement shall be made for the number of poles including all accessories and foundation block acceptably supplied and installed by the Contractor as shown on the drawing.

2.6.2 Payment

Payment shall be made for the number of units measured, as provided above, at the contract unit price each, and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of each pole

including junction cutout box.

The galvanized steel poles shall be of mild steel as shown on drawing from base plate to lantern connection, well proportioned and neatly finished. The height of the pole from the centre line of the spigot for lantern connection to the ground line and out-reach of each arm from the vertical centre line of the pole to the tip of the spigot for lantern attachment shall be as shown on Drawing. Approval of the Engineer shall be obtained before ordering the poles for manufacturing.

SP-3 LUMINARIES

Technical Specifications of LED lights issued by Energy Department, Govt. of Punjab (copy enclosed) shall be followed on the project in addition to the following:

- 1) The fixture shall offer composite system efficiency above 120 lumen/Watt (tolerance of +/-5%).

2) **Warranties & Maintenance**

The complete fixture including all accessories shall have at least four (04) years warranty, after one year of Defect Liability Period (DLP), against any manufacturing defects and failures.

The LED manufacturer /authorized agent/assembler shall not only be responsible for 5 years of warranty but also during the warranty period maintenance of the fixtures including free of cost replacements of any/all defective components/parts against manufacturing defects with the genuine products/components through the manufacturer/authorized agents under the supervision of the contractor/ maintenance agency.

The involvement of the manufacturer/authorized agent for maintenance/replacement of components is considered important because the warranty of the manufacturer becomes void if genuine product/manufacturer recommended methodology/components installation is not followed. In addition to this it is also necessary that genuine branded products those offered at the time of supply with the fixtures are provided for the 5 years of warranty / component replacement period.

Undertaking in this regard shall be submitted by the contractor as well as manufacturer/authorized agent/assembler to the Client.

Further, if required, the manufacturer/authorized agent/assembler through contractor shall provide the proof of genuineness from the manufacturer for various components provided/installed in the fixtures after fulfilling the technical requirements

The road light supplier/manufacturer shall be bound to make on site measurements to the Client's representatives wherever, applicable (i.e., where a dedicated & proper lighting network has been designed) if required, by the client for cd/m^2 (Luminance) on annual basis to ensure the compliance of the desired output light levels in accordance with CIE 140 with Luminance meter. In this manner the light output depreciation and useful life of the LEDs (50,000 burning hours) shall be compared accordingly. In case, the lighting output depreciation is not within the limits prescribed by the standard as well as any other non compliance/mal-operation of any component is noted, the

contractor/ road lighting manufacturer shall be responsible for replacement of any/all component free of cost during the warranty period. The undertaking in this regard shall be submitted through the contractor on manufacturer's letter head to the Client.

An undertaking shall be submitted by the contractor/supplier on manufacturer's letter head clearly confirming that the submitted reports are original and test values/results mentioned in the reports are authenticated.

The Client shall have the right to verify the submitted test reports directly from the testing house.

Contractor/supplier/manufacturer shall confirm that the LED chip/wafers, drivers, SPDs used are genuine and shall furnish the undertaking of LED chip/wafer, drivers & SPDs manufacturers on its letter head where applicable for use of LED chips/wafers, driver & SPDs in the fabrication/manufacturing of LED light fixture.

The Contractor shall have an active team in consultation with the Client responsible to check the non operational lights on daily basis and shall rectify within two (02) days on self response basis (pertaining to his scope only) during DLP and upto warranty after DLP, otherwise the penalty @ of PKR 200 per day of delay for each non-operational light will be charged from the Contractor. In case the fault is not on his part he will promptly notify the same to the concerned authority.

SP-4 CONDUITS AND PIPES

4.1 DESCRIPTION

When cables cross road, paved area or other services, they shall be laid in protective pipes of required size. The pipe ends after installation of cable shall be plugged to make them watertight by means of bituminized hesian or equivalent material.

Conduits/ pipes/ ducts for electrical cables shall be properly sealed with the water proofing material "Plastic Polyurethane Foam" as per relevant ASTM standard to avoid rain water entry to the conduits. The contractor shall also provide the technical data of the sealant material before the execution of the work.

4.2 GENERAL

The extent of works shown on the drawing does not indicate the exact position of conduits and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

4.3 APPLICABLE STANDARD/CODES

Latest editions of the following standards / codes shall be applicable for the materials in scope of this Section:

- | | | |
|---------|---|-------------------------------|
| BS 6099 | - | PVC conduits and accessories. |
| BS 3595 | - | PVC pipes & accessories. |
| BS 4346 | - | Cement Solvent for jointing |

4.4 MATERIAL

4.4.1 PVC Conduits and Accessories

The heavy gauge PVC conduits and accessories conforming to BS6099 shall be generally used. The PVC conduits and accessories of light gauge may be used on the project with the concurrence of the Engineer.

The PVC bends, sockets, elbows, couplings, etc. shall conform to the same specifications as for the conduits. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction.

Bending of conduits by heating or otherwise will not be allowed in any situation. The use of sharp 90-degree bends and tees will not be allowed for concealed wiring.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 63-mm diameter and depth. The junction boxes for wall light points shall have minimum dimensions of 63-mm diameter and 38 mm deep. Round junction boxes shall be provided with one piece PVC cover plate fixed to the box by means of brass screws.

4.4.2 PVC Pipe and Accessories

The PVC pipe shall be rigid. All pipes shall be minimum Class D, unless otherwise stated on drawings or bill of quantities. The buried PVC pipe should be able to withstand the external load acting upon it by continuous movement of heavy duty vehicles such as trucks. Cranes, forklift, etc. Where pipe change direction, manufactured smooth bends shall be used. Bending of pipes by heating or otherwise will be allowed in special cases only. Bending of pipes by heating shall be carried out by first filling the pipe with sand inside and then immediately removing the sand. The use of sharp 90-degree bends and tees will not be allowed. The bends shall conform to same specifications as given for PVC conduits. for joining of pipe all precautions and procedures recommended by manufacturer shall be followed.

4.5 INSTALLATION

4.5.1 Concealed Conduits

Where concealed conduit system as stated on drawings, the conduit shall be installed concealed in roof, wall, column, etc. Conduits shall be laid underfloor only where specifically stated.

When concealed the conduit shall have a minimum of 32-mm cover of concrete measured from the top of conduit to finished surface. In the reinforced cement concrete (RCC) work the conduit shall be laid before pouring of Concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and Accessories after pouring of concrete. The conduit shall be supported on top of bottom reinforcement of slab. All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting or in block masonry chase shall be made with appropriate tools and shall not be made deeper than required. The conduit shall then be fixed firmly in the recess and covered with cement concrete mixture. The work of cutting in the cement concrete work or block masonry work shall be

coordinated with the civil work. The Contractor shall obtain approval from the Engineer before starting chasing and cutting.

The termination of conduits at or near the equipment switchboard as shown diagrammatically on the drawings. The exact locations of the termination shall be coordinated with the equipment/switchboard to be installed. Any extension of conduit to suit the site condition shall be made without any extra cost. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against falling with concrete. At all terminations of conduit sharp edges of conduit ends shall be prevented to avoid the cutting or damaging of wire or cables during pulling through the conduits.

Under floor conduit shall be installed at a minimum depth of 2 inches from the finished floor level or as shown on the drawings. The conduits shall be installed empty before finishing of floor or in RCC work with a 18 SWG steel wire drawn through the conduit for pulling cable. No conduits shall be laid under floor in bathroom.

The entire conduit system shall be installed and checked before wiring as carried out. Any obstruction found shall be cleared before the installation of cable. Pull boxes and adaptable boxes shall be provided an conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements.

- Pull boxes
- For straight runs the spacing shall not be more than 180 feet
- For runs with one 90degree bend the spacing shall not be more than 90feet
- For runs with two 90degree bends the spacing shall not be more than 40feet
- Adaptable boxes
- For conduit upto 1-inch dia. the boxes shall be 2 inch in depth
- For conduit upto 1-1/2 inch dia. the boxes shall be 2-1/2 inch in depth
- For conduit upto 2-inch dia. the boxes shall be 3-1/2 inch in depth

The rectangular inspection boxes or pull boxes shall be 18 SWG heavy gauge sheet steel of suitable design to receive conduits. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than four times the cable manufacturer's recommended Bending radius of the cable. All concealed type pull boxes shall have a white plastic sheet of appropriate size fixed to the box by means of galvanized screws.

Adaptable boxes shall be 18 SWG sheet steel and painted and finished to the same quality as the Lighting distribution boards.

Wherever the conduit lengths cross the expansion joint either along the columns or slab suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed the conduit shall not crack or break.

4.5.2. PVC Pipe

Rigid PVC pipes shall be installed under roads and paved areas, at crossing with other services and at cable entering building as shown on the drawings. The depth of the pipe shall vary according to the conditions at site, and approval of Engineer shall be obtained prior to installation. In general the pipes shall be installed underground at the following depths measured from the top of the pipe:

- a) Under roads and paved surface 900 mm below the finished surface
- b) When crossing other services 250-mm vertical clearance.
for the crossing length. 500 mm horizontal clearance
with CC protective cover.

The trench of required dimensions shall be excavated and the bottom of trench cleaned and leveled. A Four-inch thick bed of fine sand shall be provided over which the PVC pipes installed after proper alignment. Where two or more pipes are installed in the same trench the clearance between pipes shall not be less than Two inches. After laying of pipe the trench shall be backfilled with clean-screened earth in layer of Four inches. Each layer shall be properly compacted.

Where underground cables enter connection terminal boxes the PVC pipe shall be installed on surface by means of PVC clamps at a maximum interval of Eighteen inches.

After installation, the ends of the pipe shall be plugged with material impervious to water and chemicals. All joints shall be sealed adequately to prevent entry of foreign elements.

The installation of pipes shall be completed in all respects including its fixing at terminations, before cabling work is started. All sharp edges and burrs shall be removed by using reamer or any approved device. The pipe shall be thorough cleaned of dirt and dust from inside. the pipes shall be installed in proper co-ordination with other works.

4.6 MEASUREMENT AND PAYMENT

4.6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation and completion for all work specified herein and as shown on the Tender drawing related to the item.

4.6.2 PVC Conduits

4.6.2.1 Measurement

Measurement shall be made for the number of running feet or running metres of conduits acceptably supplied and installed by the Contractor as a complete unit.

4.6.2.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing and completion of the laying of the conduits including jointing materials and accessories. The complete work wherever applicable shall include cutting/ chasing of civil work, for concealed conduit system, excavation and backfilling of ground for underground pipes painting, plugging, bitumen coating, etc., as applicable for each type of work.

4.6.3 PVC Pipes

4.6.3.1 Measurement

Measurement shall be made for the number of running feet or running metres of pipes acceptably supplied and installed by the Contractor as a complete unit.

4.6.3.2 Payment

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing and completion of the laying of the PVC pipes including jointing materials and accessories.

SP-5 LT CABLES

5.1 DESCRIPTION

The cable manufacturer shall be certification holder of ISO-9002 and shall be approved by the Engineer. The cables for road lighting shall be PVC insulated and PVC sheathed, 600/1000 Volt grade, designed, manufactured and tested in accordance with IEC-60502 or other equivalent international standards.

For lighting system the cables shall be single or multicore as required with stranded copper or aluminum conductors and polyvinyl chloride heat and moisture-resistant insulation of the thickness listed in IEC or British Standard.

The route of the cables shall be as shown on the drawing. Any change in route required due to site conditions shall be made in relation with other service layout and with the approval of the Engineer.

5.2 MATERIAL REQUIREMENTS

The cable shall be suitable for operation at conductor temperature upto 70° C under normal conditions.

Conductors shall be of high purity electrolytic annealed copper or aluminum wires and shall conform to the requirement of the following BS or equivalent standard.

If armouring is required it shall consist of galvanized steel wires complying with BS 1442 and shall provide conductivity not less than 50% of the phase conductor.

BS 6746: - PVC insulation and sheath of electric cables

BS 6360: Copper or Aluminum conductors in insulated cables and cords

IEC 60228: - Conductors of insulated cables

5.2.1 Cable Sizes

The sizes of LT copper conductor cables shall be as shown on the drawings. Care shall be taken so that voltage drop at the far end of the cable does not exceed 5% of the nominal voltage. Cables manufactured by the reputed firms shall be used, provided they fulfill all the requirements of the specifications.

5.2.2 Phase Identification

All cables shall have phase identification colour on the insulation of each core. The colour code of three phase circuits shall be red, yellow and blue for phase conductors and black for neutral conductor. From pole junction box upto lantern green or green and yellow striped PVC insulated wire shall be used as earth continuity conductor (ECC).

For all cables, to be supplied and installed, the Contractor shall submit complete technical data, including conductor material, insulation material, current carrying capacity, Voltage grade, weight for 100 metres etc. and all such data shall be supported by test certificates, current and temperature rise curves etc. for approval of Engineer.

5.2.3 Cable Accessories

All accessories shall be provided without additional cost for the complete cabling and wiring system. These shall include but not be limited to items such as clamps, fixing channels, connectors, cable joints (where necessary and as approved by the Engineer), clips, lugs, tapes, solders, identification tags, bushes & glands etc.

5.2.4 DATA TO BE SUBMITTED

The Contractor shall submit the following for approval of the Engineer before execution:

- Manufacturer
- Country of Origin
- Catalogue with indication of equipment proposed
- Detailed Specification
- Construction drawings

Compliance of the following shall be required:

- 1) In-process testing and tests after manufacturing (each size/type) to be supplied, as per national and international standards (as applicable) specified particularly for the project for which the cable will be ordered, including but not limited to:
 - a) Single / Multi-core Cable Manufacturing as per applicable BS or IEC standards schedule of testing.
 - b) Tests on completed cables in accordance with BS standard 6004 & BS 6346 or equivalent IEC standard / codes.

- 2) Routine tests shall be carried out from independent laboratory in the presence of Client / Consultant representatives. Review/approval of these test reports shall be carried out by the Client/Consultants.
- 3) In advance availability of sources / supporting documents with regard to material sources vis-à-vis imported Copper (in accordance with the mandatory requirements of imported copper laid down in the market input rates of material, Finance Department, Government of the Punjab), PVC used in the manufacturing of the cables ordered for a particular project including sales tax invoices from the respective material source and reconciliation quantity of the material procured with the manufactured cables. The import documents of material should consist of the following:
 - Bill of exchange.
 - Commercial invoice.
 - Packing list.
 - Beneficiary certificate.
 - Test report of Material (Copper Rod).
 - Shipment advice.
 - Bill of lading.
 - The vendor from which imported copper is purchased should be approved / registered with LME
- 4) Certificate of Registration from the client shall be submitted.
- 5) Cable inspection test protocol/procedure shall be furnished.
- 6) Pre-shipment / delivery inspection shall be carried out at Manufacturing Works of the cable manufacturers.
- 7) The samples from the cable drums supplied at site shall be taken and collected by the contractor in the presence of Client/consultant representatives for testing of same from UET or PCSIR Lahore in line with applicable standards / codes and test report of the same shall be submitted accordingly.

5.3 CONSTRUCTION REQUIREMENTS

Power supply to the poles at the road crossing shall be with PVC insulated PVC sheathed cable passing through pipe as specified and as shown on the drawings. Individual pole connections shall be by means of the power supply cable looping between poles. The cable from lighting control box shall enter first lighting unit at its three phase and neutral service cut-out and then similarly looped to the next. The luminaries on each pole shall be connected alternately to each of the three phases.

Cable routes shall consist of trenches or 100 mm PVC pipe as suitable or as shown on the drawings. The cable if laid in trench shall be at least 500 mm below the general ground and 750 mm below road (class-1) level, with sand cushion around cable and a layer of 230 mm wide bricks over sand along the entire route of cable. The bricks shall be laid in such a way to provide equal margin of cover on both sides of the cable.

Slack shall be left in cables for which purpose the cut lengths of cables shall allow about 3% more in the measured length between terminations (Engineer will verify the lengths of cables). At junction boxes, ample slack shall be left to prevent straining of cable joints due to settlement of cable trench.

For underpass luminaries PVC insulated, PVC sheathed, SWA cable shall be pulled through already laid/buried PVC pipes in underpass slabs. The pulling of cables through pipes shall be started only after the conduit (PVC) system is completely installed and all outlet boxes, junction boxes etc. are fixed in position. The cable shall be pulled in PVC pipes with care, preferably without the use of any lubricant. Where necessary, and after approval of Engineer, the cable manufacturers recommended lubricant shall be used. Use of any kind of oil or soap will not be permitted.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in cables shall not be allowed. Slack shall be left in cables for which purpose the cut lengths of cables shall allow about 3% more in the measured length between terminations (Engineer will verify the lengths of cables). At junction boxes, ample slack shall be provided to facilitate repairs in future.

Cables, whether installed in bare ground or in pipes shall not be bent to a radius less than that recommended by the cable manufacturers.

Upon completion of cable installation, the Contractor will be required to undertake testing as approved by the Engineer or the concerned department and shall comply with IEE wiring regulations. The copies of test results shall be supplied to the Engineer.

Conduits/ pipes/ ducts for electrical cables shall be properly sealed with the water proofing material "Plastic Polyurethane Foam" as per relevant ASTM standard to avoid rain water entry to the conduits. The contractor shall also provide the technical data of the sealant material before the execution of the work.

5.4 MEASUREMENT AND PAYMENT

5.4.1 Measurement

Measurement shall be made for the number of running meters for each size and type of cable complete with required accessories acceptably supplied and installed by the Contractor. For 2.5 mm² cable from junction box to lighting fitting lamp holder through hollow of pole, it shall be on each cable basis.

5.4.2 Payment

Payment shall be made for the number of running metres of each size of cable measured as provided above, at the contract unit price each and shall constitute full compensation for supplying, installing, connecting and commissioning, of the cables. Payment for 2.5 mm² cable from junction box to lighting fitting lamp holder shall be lumpsum on each cable basis.

SP-6 LIGHTING CONTROL PANEL

6.1 DESCRIPTION

The lighting control/distribution panel shall be of 14 SWG sheet steel fabricated, cubical type, totally enclosed, dust tight and vermin proof. These shall be complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to the normal requirements. The panel with all components and accessories shall be suitable for front operation and shall;

- be provided with adequate clearance from live parts so that flashovers cannot be caused by switching, vermins, pests etc.
- have all components rated for insulation class of 600 Volt minimum.
- have the components mounted so as to facilitate ease of maintenance from the front.
- be suitable for mounting on concrete foundation.

The lighting control panel shall be complete with detachable steel base frame for embedding in concrete foundation on site.

6.2 MATERIAL REQUIREMENTS

The road lighting control box shall be of 14 SWG, G.I. sheet and equipped with the following:

- One-set of three phase, neutral and earth busbars of rating as specified (site rating).
- One incoming moulded-case circuit breaker, breaking capacity & rating as specified.
- Outgoing circuit breakers, breaking capacity & rating as specified.
- Magnetic contactors as per rating specified.
- Photo-electric cell switches dust and water proof type and as per BS 5972 or WAPDA Specifications P-102 with upto date amendments.

One photo electric cell unit shall be provided to switch ON/OFF every contactor for control of lights. Photo-electric unit shall include a delay device to prevent the switching of lamps during transient changes in voltage. Each lighting circuit shall be equipped with Auto/Manual selector switch and

ON/OFF push buttons for maintenance purpose without interference with the photo cell and the whole to be enclosed in the dust and vermin proof case. Since the lighting control panel is installed on road side, therefore its outer cover shall be plain, without electrical components. A brass batten holder with ON/OFF switch and 60 watt incandescent lamp shall be provided at suitable location in the panel to facilitate maintenance during night time. Doors with hinges shall be provided so as to give maximum access for cabling and maintenance and shall be fitted with lock. Three sets of keys shall be supplied along with road lighting control box.

All necessary interconnecting wiring within the control panel shall be carried out in the factory.

Cable glands and lugs shall be provided. Three sets for incoming outgoing 4-Core up to 35 mm² Copper conductor PVC/SWA/PVC cables.

A suitable earthing terminal shall be provided inside the box.

Crimping type lugs for incoming and outgoing copper cables shall be provided.

6.2.1 Moulded Case Circuit Breakers

Moulded Case Circuit Breakers shall be provided for each distribution feed circuit. The circuit breakers shall be in accordance with IEC 60947-2. The three phase fault level shall be in accordance with the circuit requirements. The I_{cu} of all MCCBs shall be equal to 100% of I_{cs} . All MCCBs shall be capable of operating at 50 °C.

Each circuit breaker shall have integral thermal overload and magnetic type short-circuit trip devices. The thermal release shall provide inverse time overload tripping and the magnetic release shall provide instantaneous tripping or short time delay tripping where necessary, to achieve discrimination with downstream protective devices during short circuit conditions.

6.2.2 Magnetic Contractors

The contactors shall be triple pole, 400 V continuous duty type. The main contacts shall be silver tipped, but type with double break per pole. Each contactor shall be provided with 230 V AC single phase operating coil, and minimum two normally open and two normally closed auxiliary contacts wired upto terminals. But if more number of working auxiliary contacts are required then, these shall be provided according to the system requirements.

6.2.3 Indicating Lamps

Indicating lamps shall be suitable for flush mounting, complete with base and shall have rosettes of suitable colour.

6.2.4 Line-up Terminals

Line-up terminals wherever provided for control & power circuits shall be suitable for voltage and size of conductors as indicated on drawing.

The line-up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

6.2.5 Data to be Submitted

The Contractor shall submit the following for approval of the Engineer before execution;

- Manufacturer
- Country of Origin
- Catalogue with indication of equipment proposed
- Detailed Specification
- Construction drawings
- General arrangement and proposed foundation details.
- Details of materials used for weather and dust proofing.

6.3 CONSTRUCTION REQUIREMENTS

The road lighting control panel box shall be installed near transformer at location shown on the drawing. The Contractor shall ensure coordination with the civil contractor to avoid damage to the completed works. The Contractor shall provide foundation bolts and grout them in cement concrete with the approval of the Engineer. All installation material required for the satisfactory erection, such as bolts, nuts, washers, supporting steel etc. shall be provided and installed by the Contractor. The panel shall be installed upright and in level and shall be firmly and rigidly fixed on the concrete supports. Panel shall be erected as per manufacturer's instructions and as approved by the Engineer.

Loose parts dispatched by the manufacturer, shall be installed and connected as per assembly drawing. Any safety locking of metres, relays etc. provided by the manufacturer, for safe transport shall be released only after the panel is installed in position. The Lighting Control Panel shall be tested and commissioned in the presence of the Engineer.

Panel openings for cables shall be properly sealed with the water proof material “Plastic Polyurethane Foam” as per relevant ASTM standard to avoid rain water/animal entry to the panel. The contractor shall also provide the technical data of the sealant material before the execution of the work.

6.4 MEASUREMENT AND PAYMENT

6.4.1 Measurement

Measurement shall be made for each panel complete with all components and accessories as given in bill of quantities acceptably supplied and installed by the Contractor as completed job.

6.4.2 Payment

Payment shall be made for the number of panels measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of panels including bolts, supporting steel base, nuts, washers, tapes and earthing etc.

SP-7 EARTHING

7.1 DESCRIPTION

Earthing system as shown on the drawing shall be installed by the Contractor. The earthing system shall give earth resistance, including the resistance of soil, earth leads and ECC, equal to or less than one ohm.

7.2 MATERIAL REQUIREMENTS

7.2.1 Earthing by Earth Rods

The earth rod shall be of steel and shall be protected against rusting by a thick exterior layer of copper (not less than 0.33 millimeter), permanently molded or electrolytically deposited on a high strength steel core which shall provide rigidity for easy driving without bending. The earth rod shall have nominal dia of 16 mm with chamfered head of 2x45 mm (chamfer). The overall length of the rod shall be 3000 $\pm$ 5 mm.

7.2.2 Earthing Lead

The copper conductor used for earth wire shall conform to the latest revision of IEC 228, IEC 228A. The size and number of individual conductor shall be as specified in the applicable standards.

7.2.3 Earth Continuity Conductor

Earth continuity conductor (ECC) shall be hard drawn bare copper wire, or single core PVC insulated copper conductor cable of given size. The earth continuity conductor shall be connected at one end to the earth rod through switch clamp/eye bolts as shown in the drawings at the other end to the relevant equipment to be protected as mentioned in the specification, BOQ and shown on drawing.

The specifications for single core PVC insulated cables used as ECC shall be same as those in relevant sections of technical specifications.

7.2.4 Data to be Submitted

The Contractor shall submit the following for approval of the Engineer before execution;

- Manufacturer
- Country of Origin
- Catalogue with indication of equipment proposed
- Detailed Specification
- Construction drawings

7.3 CONSTRUCTION REQUIREMENTS

7.3.1 General

For earthing of equipment proper size copper or brass thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or terminations shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

The earth continuity conductor shall, in general, run in cable trench or in conduits/pipes. Where laid along underground cables, these shall be laid directly underground in unpaved areas and in pipe under paved areas.

7.3.2 Earth Continuity Conductor

The body of all lighting control panels shall be connected to earth by specified size of ECC. All other metal work shall also be connected to earth by suitable size of ECC so that earth resistance is less than five ohm.

At joints or terminations, the ECC shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

7.3.3 Earth Resistance Test

Earth resistance tests shall be done on the earthing system by separating and reconnecting conductor. The resistance of earthing leads in the installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements.

7.4 MEASUREMENT AND PAYMENT

7.4.1 Measurement

For earth continuity conductors (ECC) measurement shall be made for each size of copper wires on per running meter basis acceptably supplied and installed by the Contractor.

7.4.2 Payment

Payment for copper rod type earth point shall be made for each point and provided as above at the Contract Unit price each and shall constitute full compensation for supplying, installing, connecting and testing including earth rod, excavation, backfilling, civil work for inspection chamber, etc. as shown

on the drawings. Payment of earth continuity conductors (ECC) shall be made for the number of running meters measured at the Contract unit price and shall constitute full compensation for supplying, installing & connecting including all installation accessories.

SECTION – 10

CABLE TRAYS

1.0 GENERAL

The work under this section consists of supplying, installing, and commissioning of all material and services of the complete cable trays as specified herein, shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the layout with the Engineer and co-ordinate at Site with other services for exact route, location and position of the cable trays for electrical lines.

The cable trays with accessories shall also comply with the General Specifications for Electrical Works and with other relevant provisions of the Tender Document.

The extent of works shown on the drawing does not indicate the exact position of cable trays. The Contractor shall ensure exact location and route of cable trays in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The Contractor should deliver, store and handle materials and products in a manner to prevent damage.

2.0 APPLICABLE STANDARDS/CODES

Latest editions of the following standards / codes shall be applicable for the materials in scope of this Section:

BS 729 Hot dip galvanized coating on iron and steel articles

3.0 PRODUCTS

3.1 The cable tray system shall be of one manufacturer and shall include factory-made trays, tray fittings, connectors and necessary accessories and supports to form a complete cable support system.

The cable tray system shall include the following factory -made tray elements:

- (a) straight cable trays and ladders
- (b) fittings as horizontal and vertical bends of various angles, crosses, tees, wyes, reducers, vertical riser elements
- (c) connectors

(d) all necessary fixing accessories.

- 3.2 Manufacturer's standard accessories shall be used and site fabrication shall not be permitted.
- 3.3 Horizontal run of cables laid on cable tray and exposed to direct sunlight shall be provided with covering at higher level to allow for ventilation. Cable tray shall be raised 15 cm from finished floor level.

4.0 MATERIALS

- 4.1 The whole of the tray work, trays, fittings, supports shall be of mild steel hot dipped galvanized after manufacture to BS 729. The thickness of the protective sheath on any element shall not be less than 55 microns.
- 4.2 Cable trays shall be constructed from mild steel hot dip galvanized and of minimum thickness of 1.5mm.
- 4.3 Insert elements, bolts, screws, pins, etc., shall be mild steel cadmium plated.
- 4.4 Tray work shall have oval perforations. Ladder type trays shall be used for vertical runs as approved by the Engineer.
- 4.5 All trays (straight and fittings) shall be welded construction and be a heavy duty returned-flanged, perforated type, unless specified otherwise. The minimum thickness of heavy duty returned flanged cable trays shall be 1.5mm.
- 4.6 Tray components shall be accurately rolled or formed to close tolerances and all edges rounded. Flanges shall have full round smooth edges.
- 4.7 Ladder racks shall be of similar construction. The rungs shall be spaced at maximum 300 mm. The system shall allow for installing additional rungs and for replacement of rungs.
- 4.8 For all trays, flanges shall be a minimum of 50 mm deep, unless otherwise specified.
- 4.9 Cable tray width and radius of curved sections shall be selected to suit the number of cables as shown on drawings and to the approval of the Engineer
- 4.10 Cable trays and accessories installed in hazardous and extremely corrosive environments shall be heavy duty GRP or 316 S31 grade stainless steel.

5.0 INSTALLATION

5.1 Installation

- 5.1.1 Drilling, machining or cutting shall not be carried out after application of protective coat, unless previously agreed by the Engineer. If cutting or drilling is necessary, edges shall be cleaned up and painted with zinc based paint before erection.
- 5.1.2 Installation of vertical runs of tray along the line of vertical expansion joints in structure of the facility shall not be allowed.
- 5.1.3 Cables shall be fixed to the trays by means of PVC covered saddles or straps secured with brass or cadmium plated bolts, nuts and washers.
- 5.1.4 20% spare capacity shall be maintained once all cables have been installed on trays. Double banking of cables shall not be permitted space between adjacent cables shall be not less than the radius of the bigger cable.

Trays shall not be smaller than the minimum size stated on the Drawings or specified later and shall be so sized; if not specified, the Contractor shall calculate the size of the tray and submit to the Engineer for approval. The Contractor shall check the minimum size as specified is large enough for his requirements and provide 20% spare capacity for future use.

5.2 ERECTION

- 5.2.1 Cable trays arranged one above the other shall have spacing in relation to their width not exceeding a ratio of 1:2 with a minimum distance of 150 mm.

5.2.2 Supports

Install fixings and supports:

- (a) at 3 meter centres
- (b) 50 mm from bends, tees, intersections and risers
- (c) as close as practicable to joints
- (d) each side of expansion joints.

- 5.2.3 Supports shall be selected from the following types, to suit the site conditions:

- (a) M12 steel threaded drop rods fixed to ceilings complete with GI channels or brackets

- (b) wall support brackets
- (c) cantilever arms
- (d) steel channels

- 5.2.4 The cable trays shall be fixed in accordance with site conditions and manufacturer's recommendations.
- 5.2.5 Join cable tray and accessories with hardware per manufacturer's recommendations.
- 5.2.6 Avoid mid-span joints.
- 5.2.7 The Contractor shall submit, as required, all calculations relating to tray work and tray supports demonstrating acceptable mechanical stresses and sag.
- 5.2.8 Cable trays installed on roofs shall be supported using GI brackets or concrete blocks. Removable cable tray cover shall be fitted.
- 5.2.9 Access shall be available at all times to remove or replace cables with a minimum of 400 mm between trays and physical obstructions, A/C ductwork etc.

5.3 EARTHING

- 5.3.1 Cable trays and accessories shall be electrically and mechanically continuous throughout their length.
- 5.3.2 The entire cable tray system shall be bonded and 12 mm x 2.5 mm tinned copper links shall be bolted across each joint in the system by means of bronze nut and bolts, complete with flat and spring washers.
- 5.3.3 All cable trays shall be provided with earth continuity copper tape along the whole route of cable trays which shall be bonded to the main earthing system of the facility. The earth continuity copper tape shall be fixed on cable tray by means of PVC covered saddles or by other means approved by the Engineer.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation and completion for all work specified herein and as shown on the Tender drawing related to the item.

6.2 **Cable Trays**

6.2.1 **Measurement**

Measurement shall be made for the number of running feet or running meters of cable trays acceptably supplied and installed by the Contractor as a complete unit.

6.2.2 **Payment**

Payment shall be made for the total numbers of units measured, as provided above, at the Contract unit price each. The payment shall constitute full compensation for supplying, installing and completion of the laying of the cable trays including jointing materials and accessories.

SECTION - 11

LOW VOLTAGE (LV) DISTRIBUTION BOARDS

1.0 GENERAL

The work under this section consists of design, manufacturing, fabricating, supplying, installing, connecting, testing and commissioning of all material and services of the complete Low Voltage Distribution Boards as specified herein, shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact position of the electrical lines and equipment.

The Low Voltage Distribution Boards shall also comply with the General specifications for Electrical & Communications Works Section-8001 and with other relevant provisions of the Tender Documents.

The Low Voltage Distribution Boards shall be sheet steel fabricated. These shall be suitable for surface mounting, semi-recessed or recessed in wall mounting. The Low Voltage Distribution Boards shall be totally enclosed, dust and damp proof. The Low Voltage Distribution Boards shall be complete in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the normal requirements.

All components shall be installed on a common mounting plate inside the enclosure and protected from the front with screwed sheet steel front plate. The enclosure shall be provided with rubber gasketing and a lockable hinged door with cam fastener.

The distribution board shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the distribution board.

The cabling inside the distribution board shall be suitably harnessed by means of straps or cords. An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of distribution board at two points.

The LV Distribution Boards, in general, shall;

- be suitable for indoor installation & operation
- be suitable for operation and maintenance from front side
- be suitable for both 415 Volt AC, three phase 4 wire and 230 Volt AC, single phase 2 wire, 50 Hz system

- have all components rated for insulation class of 500V minimum for three phase and 250 Volt for single phase system
- be designed for flush mounting of all instruments on the front
- be provided with adequate clearance from live parts so that flash overs can not be caused by switching, vermins, pests etc.
- have incoming/outgoing cable termination arrangements. The power cables shall be directly connected to the terminals of TP 500V MCCBs of current ratings of 100 Amps and above. The SP/TP MCBs and/or MCCBs of current ratings upto and including 100 Amps shall be connected to DIN rail mounted wiring terminals of appropriate ratings, numbers and sizes for the outgoing wiring cables
- be provided with name plate on the front side of door
- be provided with pocket inside of door for safe keeping of the detailed as-built wiring/shop diagrams of the switch board
- have provisions for incoming and outgoing cables entry, connections and termination arrangements from top and/ or bottom plates as per site requirements
- have all openable doors grounded with the use of flexible copper cable/strip of at least 10 mm² cross-sectional area

2.0 APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section :

- BS 4752-1 - Triple Moulded Case Circuit Breaker
- IEC 60947 - Single and Triple Miniature Circuit Breaker
- IEC 60947 - Low Voltage Switch gear and Control gear
- IEC 60439 - Factory Built Assemblies of LV Switch gear
- IEC 60475-2 - Switch gear and control gear for Voltages upto & including 1kV
- BS 88 - HRC Fuses
- IEC 60073 - Colors for indicator lights and push buttons
- IEC 60446 - Identification of insulated/bare conductors

3.0 MATERIAL

3.01 Sheet Metal Work

The surface mounting Low Voltage Distribution Board shall be fabricated with 14 SWG sheet steel and the semi-recessed or recessed mounting type shall be fabricated with 16 SWG sheet steel.

The complete sheet steel metal work of the Low Voltage Distribution Board shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint
- Two coats of weather proof powder paint in approved colour

3.02 Components

The Low Voltage Distribution Board shall be provided with components as specified in the Specifications, mentioned in the Bill of Quantities and as shown on the Tender Drawings, required for the satisfactory operation of the distribution board and of the electrical system.

Typical component specifications are given below:

3.02.1 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on bus bars and these shall be red, yellow and blue for phase and white for neutral. The earth bus bar shall be green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

3.02.2 Moulded Case Circuit Breaker (MCCB)

The MCCB shall be moulded case, triple pole, rated for 500 Volt AC. The Operating current ratings and Rupturing capacities shall be as mentioned in the relevant items of the Bill of Quantities and as shown on the drawings. The MCCB's shall have fixed Magnetic Short circuit and fixed Thermal Overload protections. However, the short circuit breaking capacities of triple pole moulded case circuit breaks shall be

more than or at least, 25kA as per IEC 60157-2, unless specified elsewhere. All incoming Triple pole circuit breakers shall be Moulded Case Circuit Breakers. The Icu of all MCCBs shall be equal to 100% of Ics. All MCCBs should be suitable for operation (rated current) at 50 °C. Icm should be at least 2.2 times of Icu.

The Moulded Case Circuit Breakers shall be installed in the LV switchboards such that the switching lever of the Main Incoming MCCB shall be accessible from the front of the panel with the front door in closed position and the switching levers of all outgoing MCCB's and MCB's are accessible through the front plate inside the switchboards for operations. Circuit Numbers and Designation on all circuits shall be clearly marked to facilitate connection and maintenance.

3.02.3 **Miniature Circuit Breaker (MCB)**

The MCB's shall be Single pole 250 Volt of current ratings as shown on the drawings. These shall have fixed magnetic short circuit and fixed thermal overload protections. The Single pole miniature circuit breakers shall have a 6 kA short circuit breaking capacity as per International standard IEC 60898 and rated for operation at 50 °C.

The Miniature Circuit Breakers shall be installed such that their switching levers are accessible through the front plate inside the Switch Boards for operations. Circuit Numbers and Designation on all circuits shall be clearly marked to facilitate connection and maintenance. These Circuit Breakers shall be suitable for working on lighting and power circuits.

3.02.4 **Push Buttons**

Push buttons shall be momentary make break contact type (normally open/normally close). These shall be suitable for flush mounting on Distribution board, plastic face plate etc. Push buttons shall have round/square head.

3.02.5 **AC Voltmeters**

AC Voltmeters shall be Digital type and shall be suitable for flush mounting on front door of the Distribution Boards. The front dimensions shall be 96 mm Wide and 48 mm high. The voltmeters shall have 3-1/2 digit, 0.55 inch display.

3.02.6 **Ammeters**

AC Ampere meters shall be Digital type and shall be suitable for flush mounting on front door of the Distribution Boards. The

front dimensions shall be 96 mm wide and 48 mm high. The Ampere meters shall have 3-1/2 digit, 0.55 inch display.

3.02.7 Voltmeter Selector Switch

The voltmeter selector switch shall be complete with front plate, grip handle, and RY-YB-BR-OFF-RN positions.

3.02.8 Current Transformers

Air cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 and have 5 amps secondary.

3.02.9 Air Break Magnetic Contactors

The contactors shall be air break, triple pole, 415 Volt suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with 230 Volt AC single phase operating coil, and minimum two normally open (NO) and two normally closed (NC) auxiliary contacts wired up to terminals. The number of working auxiliary contacts shall be provided according to the system requirements.

3.02.10 Indicating Lamps

Indicating lamps shall be suitable for flush mounting, complete with base, either 230 Volt neon or 12 Volt incandescent lamp through auxiliary transformer and shall have rosettes of suitable colour.

3.02.11 Line up Terminals

Line up terminals wherever provided for control of lighting, power and control circuits shall be suitable for voltage and size of conductors as indicated on drawings and as mentioned in the respective BOQ items. The line-up terminals shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

4.0 INSTALLATION

The location of distribution boards are shown diagrammatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in coordination with other equipment.

Low Voltage distribution board for recessed mounting in wall shall be installed such that the door shall finish flush with the surface of wall. The recess

mounted distribution board shall be installed before the plastering of walls. The DB shall be protected to avoid any damage due to the civil work.

All loose parts despatched separately with the DB shall be installed as per manufacturer's instructions and all adjustments or setting shall be made, as required. All screws, nuts and bolts used for fixing the distribution board shall be galvanized. The distribution boards installation shall include connecting all incoming and outgoing cables. The cable entry in the boards shall be provided from top or bottom as required.

The distribution board body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer. The LV distribution boards shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

5.0 MEASUREMENT AND PAYMENT

5.01 General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include design, fabrication, supply, installation, testing, commissioning and completion for all works specified herein and/or as shown on the Tender Drawing related to the item.

5.02 LV Distribution Board

5.02.1 Measurement

Measurement shall be made for the number of each type/designation of LV distribution boards acceptably supplied and installed by the Contractor as a complete job.

5.02.2 Payment

Payment shall be made for the number of each type/designation of jobs measured, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the LV distribution boards, including fixing arrangement and accessories for complete installation.

SECTION - 12

MEDIUM VOLTAGE SWITCHBOARD

1.0 SCOPE OF WORK

The work under this section consists of supplying, installation, testing & commissioning of all material and services of the complete Medium Voltage (MV) switchboards and accessories as specified herein or as shown on the tender drawings and given in the Bill of Quantities. The switchboard shall be got approved by WAPDA, before installation.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact location and position of the MV panel.

The MV Switchboard with accessories shall also comply with the WAPDA Specifications P-44: 96, General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Tender Document.

2.0 GENERAL

The MV switchboard shall be sheet steel fabricated cubicle type totally enclosed type with IP classification IP44 dust tight and vermin proof. It shall be complete in all respect with material and accessories factory assembled, tested and finished according to the specifications and to the normal requirements.

The switchboard shall be suitable for front operation and shall:

- be suitable for addition of units on either side
- be provided with adequate clearance from live parts so that flashover cannot be caused by switching surges, vermin, pests, etc.
- be designed for flush mounting of all instruments on the front door
- have all incoming and out going connections from the bottom
- have the components mounted so as to facilitate ease of maintenance from the front
- have provision for lamp test, alarm test, alarm accept and reset facility
- be suitable for mounting on cable trenches
- be provided with anti-condensation heaters controlled automatically through adjustable thermostats for maintaining required safe operating temperature inside the panel and also avoid condensation. The heater shall also be manually operable and provided with protective miniature circuit breaker and **ON** indication lamp

3.0 APPLICABLE STANDARDS/CODES

Latest editions of the following standards and codes shall be applicable for the materials within the scope of this section.

BS 3245	-	Bus bars
BS 30	-	Meters
IEC 5	-	High voltage AC circuit breaker
IEC 185	-	Current transformers
IEC 186	-	Potential transformers
BS 3941		

4.0 MATERIAL

4.1 Medium Voltage Switchboard

The switchboard shall be manufactured and fabricated with angle-iron framework, welded, grounded, finished and clad with 12 SWG sheet steel.

The switchboard shall be supplied divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels shall be provided for fixing required size of 15kV XLPE cable. Adequate number of eyebolts shall be provided to facilitate handling.

An earth bar of appropriate cross section shall be provided and connected to the body of all sections of the switchboard. The external earth terminal shall be provided for main earth connection. The doors shall be grounded by flexible strap of copper braids.

The control cabling inside the switchboard shall be suitably numbered and harnessed by means of straps or cords. All indicating, selecting and control equipment shall be suitably arranged and labeled with clear indelible printing, indicating the rating and designation of fuses, switches etc. The nameplates shall be provided on the front of panel for each circuit and component which is accessible from outside. The nameplates shall be of stainless steel with engraved equipment designation having minimum width of 5mm. Other labeling on the switchboard such as danger signs, voltage, switchboard/ panel identification shall be of sufficient size, legible from a distance of 10 meters.

All metal work of the switchboard shall be;

- cleaned down to bare shining metal
- De-rusted and de-greased
- Two base coats of anti-corrosive RED OXIDE paint.
- Finished inside and outside with Off White powder paint

Any interlocking if required inside the MV switchboard and between switchboard and other equipment should be provided.

4.1.1 Capacity and Basic Data

The switchboard shall be designed to conform to the following requirements;

Rated Current	:	As shown on drawings.
Rated Nominal Voltage	:	11 kV
Rated Maximum Voltage	:	15 kV
Power Frequency Withstand Voltage.	:	36 kV for 1 minute
Rated Short Circuit Capacity	:	450 MVA at 11 kV for one second.
Rated Breaking Currents (1 second rating)		
a. Symmetrical	:	18.4 kA
b. Asymmetrical	:	25 kA
Rated Making Current	:	2.55 times rated symmetrical Breaking current
Operating Duty	:	B-3 -MB-3 -MB
Impulse withstand Voltage	:	95 kV
Control Voltages		
Indication/Metering	:	110 Volt AC from secondary of PT
Tripping Voltage	:	Series tripping or 110 Volt DC from capacitor trip unit.

4.2 Circuit Breaker

The circuit breakers shall be triple pole, with drawable type with arc interruption in vacuum. The operating characteristics and technical data shall be as given in article 4.1.1 of this section. The bidder shall submit with his offer the type and details of equipment proposed.

The circuit breaker shall have trip free, direct acting and manually operated drive mechanism. For manual operation a handle shall be provided. The unit shall have roll-out trucks and channels for horizontal withdrawal. Interlocking device shall be provided such that the breaker can be closed only when it is in fully plugged-in or fully withdrawn position and withdrawal of circuit breaker is only possible in the open or isolated position. Safety shutters shall be provided which will automatically cover the live contacts as the circuit breaker is withdrawn. Other interlocks as essentially required for safe and proper operation of circuit breaker shall be provided. Barriers of approved heat resisting, non-tracking-insulating material shall separate the circuit breaker phases.

A triple pole grounding switch or a suitable earthing device shall be provided for cable and bus bar earthing and shall be rated to safely carry the fault current due to inadvertent closing of supply circuit breaker and also for making duty on a fault.

A triple pole grounding switch or a suitable earthing device shall be provided for cable and bus bars earthing, complete with mechanism for interlocking it with the circuit breaker and the roll-out truck and mechanical indication to show the position of grounding switch. The circuit breaker shall have automatic mechanically operated **ON** and **OFF** position indications. Luminous indications shall be provided with **ON/ OFF** and **TRIP** position. Additional indication lamps as shown on the drawings shall also be furnished. The circuit breakers shall be provided with **ON-OFF** push buttons.

Each circuit breaker shall be provided with at least three normally closed and three normally open potential free auxiliary contacts rated for 10 Amp. 230Volt AC. Provision shall be made for remote indication of the circuit breakers position/status.

A test circuit shall also be provided to facilitate testing operation of circuit breaker manually and by protective relays. Test socket with plug shall be provided for testing the relays.

The circuit breaker shall be complete with necessary secondary wiring with ferrules to indicate the circuit. Protection shall also be provided for all control circuits.

4.3 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely insulated and mechanically braced to safely withstand the stresses due to short-time momentary current under the fault conditions. The phase identification of bus bars shall be by the colors applied on the full length and these shall be red, yellow and blue. The clearances shall not be reduced on account of the busbar insulation or the phase barriers.

4.4 Current Transformers

Each circuit breaker shall be provided with current transformers having following ratings and characteristics:

Type	:	Cast resin
Number	:	Three single phase units
Burden	:	Suitable for load of protection and instrumentation circuits.
Accuracy	:	5% for protection and 1% for measuring with security factor 5.
Duty	:	For operating relays and instruments
CT ratio	:	As shown on the Tender Drawings
No. of cores	:	as required/as shown on drawings
Rated dynamic Current	:	2.55 times rated symmetrical short circuit current

4.5 Potential Transformers

Potential transformers (PTs) shall be provided as shown on the Tender Drawings and having the following ratings and characteristics:

Type	:	Cast resin
Number	:	Three single phase units
Burden	:	Suitable for load of protection and instrumentation circuits.
Accuracy	:	Class 1.0

Duty	:	For operating relays and instruments. Each PT shall be designed to have independent secondary Windings of specified ratio for connection in star or open delta.
Voltage ratio	:	11kV/11Vs
Rated voltage factor	:	1.2 continuous and 1.0 for 30 seconds
Rated dynamic Current	:	2.55 times rated symmetrical short circuit current

4.6 Capacitor Shunt Trip Unit

In case series tripping is not provided then each circuit breaker in the MV switchboard shall be provided with 110 Volt DC trip coils, which will supply power through the capacitor trip units. The trip coils shall be fed through the relay contacts and the 'OFF' push button.

The capacitor trip unit will be fed from 110 volts secondary of potential transformer. The capacitor trip unit shall be suitable for performing two successive tripping operations carried out within five minutes.

4.7 Protective relays

The circuit breakers shall be provided with inverse definite minimum time non-directional over-current relays for phase and earth fault protection. The relays shall have the following common characteristics unless otherwise specifically mentioned:

Phase fault over current setting range:

Inverse	:	50-200 of CT secondary rating
Instantaneous	:	20-800 of CT secondary rating.

The instantaneous elements shall also have infinity setting to block their operation.

Ground-fault	:	20-80 of CT secondary rating with instantaneous element as for phase fault unit.
Time setting range	:	0-1 second
Connection	:	Secondary of CT

Auxiliary supply	:	Series tripping or through 110V
Tripping DC from capacitor trip units in each breaker panel.		
Indications/control	:	110 Volt DC from secondary of PT.
Heaters and alarm	:	220 Volt DC from LV switchboard.
Auxiliary Contacts	:	Provision for remote indication as required

The relay shall preferably be triple pole type and have positive action without chatter.

4.8 **Meters & Selector Switches**

The meters to be provided on switchboard shall be as specified below:

4.8.1 **Ammeter and Voltmeter**

The ammeter and voltmeter shall be moving iron spring controlled having front dimensions of 144 x 144 mm. Voltmeters shall have measuring range of 0-15 kV and ammeters measuring range shall be as shown on the drawings. Ammeters and voltmeters shall conform to BSS accuracy class 1.5 and suitable for connection to the secondary of PTs and CTs installed on the switchboard.

4.8.2 **Selector Switches**

Ammeter selector switch shall be R-Y-B-OFF and voltmeter selector switch RY-YB-BR-OFF. The selector switches shall be complete with front plate and operating lever.

4.8.3 **kWh and kVarh Meters**

Kilowatt-hour (kWh) and Kilo volt ampere-hour (kVARh) meters shall be suitable for 3 phase 3 wire 50 cycles balanced and unbalanced loads. The kWh meter shall also be provided with maximum demand indicator and built in switch for operation as per WAPDA requirements.

4.8.4 **Alarm Indication**

On occurrence of any fault in the system and subsequent tripping of circuit breakers audio alarm shall be provided on the Switchboard. Push buttons shall be provided on Panel for independent resetting of the audio alarm and fault-indicating lamp. At least two potential free contacts rated 10 Amp. AC or DC shall be available for remote connection.

4.9 Tools

One complete set of tools for routine operation setting and maintenance of MV switchboard including protective relays as recommended by manufacturer of each component shall be furnished within the price quoted for the MV switchboard. Switchboard shall be provided with independent set of tools placed in suitable box. The bidder shall furnish details of tools with his offer.

5.0 INSTALLATION

The MV switchboard shall be installed at location shown on the drawing. The cable trenches shall be constructed as part of civil works. The Contractor shall co-ordinate with the civil works for providing and openings, holes, etc., in time to avoid and breakage/damage to completed works. In case the provisions in civil works for installation of electrical equipment are not made or made incorrect, the same shall be rectified by the Contractor at his own cost and to the satisfaction and approval of Engineer.

The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material approved by the Engineer. All installation materials for physically erecting the switchboard such as bolts, nuts, washers, supporting steel, etc. shall be provided and installed by the Contractor. The switchboard shall be installed upright and in level and shall be firmly and rigidly bolted on the floor and concrete supports. All wiring external from MV switchboard to alarm indication control unit protection interlock circuits and for auxiliary power supply for heaters, etc., will be furnished and installed by the Contractor in consultation with the Engineer.

The switchboard shall be erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. And safety locking of meters relays, etc., provided by the manufacturer for safe transport shall be released only after the switchboard is erected in position.

Necessary provision shall be made in the MV switchboard for incoming/outgoing cables and installation of cable termination kits, keeping in view both cable and switchboard manufacturer's recommendations. The cable armour shall be connected to the earth system.

The switchboard body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer. The tests to be carried out shall be as recommended by the international standard to which the switchboard is manufactured and/or as recommended by manufacturer» but as a minimum the tests given in section "Testing" of these Specifications shall be carried out.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include design supplying, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

6.2 Medium Voltage Switchboard

6.2.1 Measurement

Measurement shall be made for the complete job of MV Switchboard including all mounting, installation and operational accessories acceptably supplied as a complete job.

6.2.2 Payment

Payment shall be made for the total number of jobs measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installation, testing and commissioning of the MV switchboard including all mounting, installation and operational accessories.

SECTION - 13

LOW VOLTAGE SWITCHBOARDS, MAINTENANCE BY-PASS SWITCH, POWER FACTOR IMPROVEMENT PLANT AND BUS TIE DUCT

1.0 SCOPE OF WORK

The work under this section consists of design, manufacturing, fabricating, supplying, installing, testing, and commissioning of all material and services of the complete LV (LV) (415 Volt) switchboard, Maintenance By-Pass Switch (MBS), Power Factor Improvement (PFI) Plant and Bus Tie Duct (BTD) for indoor installation as specified herein, shown on the Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical equipments and power & control cables layout with the Engineer and co-ordinate at site with other services for exact locations and positions of the electrical lines and equipments.

The LV (415 Volt) switchboards, MBS, PFI Plant and BTD with all other required accessories shall also comply with the General specifications for Electrical Works Section-8001 and with other relevant provisions of the Tender Documents.

2.0 GENERAL

2.1 Low Voltage (415 Volt) Switchboard

The LV (415 Volt) switchboard shall be sheet steel fabricated. The LV (415 Volt) switchboard shall be free standing cubicles on floor.

The free standing cubicles shall be modular in design with facility and provisions for expansion/ addition of additional cubicles in future

These shall be suitable for indoor installation on cable trenches. The LV (415 Volt) switchboard shall be totally enclosed, dust and damp proof. The LV (415 Volt) switchboard shall be complete in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the normal requirements.

All components of LV (415 Volt) switchboards shall be installed on a common mounting plate inside the enclosure. The enclosures of LV (415 Volt) switchboards and Bus Tie Duct shall be provided with rubber gasket and a lockable hinged door with cam fastener. The switching lever of the Main incoming Air Circuit Breaker (ACB)/Moulded Case Circuit Breaker (MCCB) of LV (415 Volt) switchboards shall be accessible from outside of the panel doors in closed position. Switching levers of all outgoing MCCBs and MCBs shall only be accessible with the panel doors in open position.

The LV (415 Volt) switchboards shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for LV (415 Volt) switchboards to accommodate the cables and conduits may be provided. The box shall be of the same material and finish as the switchboard.

The cabling inside the switchboard shall be suitably harnessed by means of straps or cords. For the LV (415 Volt) switchboards an earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of switchboard at two points.

The LV (415 Volt) switchboards, in general, shall;

- be suitable for indoor installation & operation
- be suitable for operation and maintenance from front side
- be suitable for 415 Volt, 3 phase 4 wire, 50 Hz system
- have all components rated for insulation class of 600V min
- be designed for flush mounting of all instruments on the front
- be provided with adequate clearance from live parts so flash overs can not be caused by switching, vermin, pests, etc.
- have incoming/outgoing cable termination arrangements. The power cables shall be directly connected to the terminals of TP 500V MCCBs of current ratings of 100 Amps and above. The SP/TP MCBs and/or MCCBs of current ratings upto and including 100 Amps shall be connected to DIN rail mounted wiring terminals of appropriate ratings, numbers and sizes for the outgoing wiring cables
- be provided with name plate on the front side of door for each incoming/outgoing circuits
- be provided with pocket inside of door for safe keeping of the detailed as-built wiring/ shop diagrams of the switchboard
- have provisions for incoming and outgoing cables entry, connections and termination arrangements from top and/or bottom plates as per site requirements

- have all openable doors grounded with the use of flexible copper cable/strip of 10 sqmm cross-sectional area, at least

2.2 **Maintenance By-Pass Switch (MBS)**

The Maintenance by-pass switch shall be used for supply of power either from power transformer or DG set in case of faults in AMF Panel.

2.3 **Power Factor Improvement (PFI) Plant**

The Power factor Improvement Plant shall be used for improving the system power factor to keep the same within the limits as prescribed by WAPDA.

2.4 **Low Voltage (415 Volt) Bus Tie Duct (BTD)**

The LV (415 Volt) Bus Tie Duct shall be sheet steel fabricated. The LV (415 Volt) Bus Tie Duct shall be suitable for indoor installation. The Bus Tie Duct shall be suitable for indoor mounting on CC wall and RCC columns surfaces as shown on the drawings. The Bus Tie Duct shall be totally enclosed, dust and damp proof.

The Bus Tie Duct shall be designed to withstand a short circuit as specified for the associated LV switchboard. The current rating shall be as given in Bill of Quantities. The Bus-Tie Duct shall be three phase and neutral, rated for 415 Volt, 50 Hz system.

The LV (415 Volt) Bus Tie Duct shall be complete in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the normal requirements.

The Contractor shall supply the bus-tie duct keeping in view all the installation, operation and maintenance factors as per site conditions and requirements and shall be solely responsible for the proper design configurations and dimensions of the bus-tie duct for complete alignment.

The LV (415 Volt) Bus Tie Duct, in general, shall;

- be suitable for indoor installation & operation
- be suitable for operation and maintenance from front/ rear sides
- be suitable for 415 Volt, 3 phase 4 wire, 50 Hz system
- have all components rated for insulation class of 600V min
- have name plates on the front & rear sides at every 5 meter

- have suitable provisions for incoming and outgoing cables entry, connections, termination arrangements as per site requirements
- have all openable doors grounded with the use of flexible copper cable/strip of atleast 10 mm² cross-sectional area

3.0 APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section :

- | | | |
|-----------|---|---|
| IEC 947 | - | Triple pole Air Circuit Breakers |
| BS 4752-1 | - | Triple pole Moulded Case Circuit Breaker |
| VDE 0641 | - | Single and Triple pole Miniature Circuit IEC 947 Breaker |
| IEC 947 | - | LV Switch gear and Control gear |
| IEC 439 | - | Factory Built Assemblies of LV Switchgear |
| IEC 4752 | - | Switch gear and control gear for Voltages upto and including 1 kV |
| BS 88 | - | HRC Fuses |
| IEC 73 | - | Colors for indicator lights and push buttons. |
| IEC 446 | - | Identification of insulated/bare conductors |

4.0 MATERIAL

4.1 Low Voltage (415 Volt) Switchboard

4.1.1 Sheet Metal Work

The enclosures for the LV (415 Volt) switchboards shall be fabricated with 14 SWG sheet steel. The front doors shall be fabricated with 12 SWG sheet steel.

The complete sheet steel metal work of the LV (415 Volt) switchboards shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint.

- Two coats of weather proof powder paint in approved colour.

4.1.2 **Components**

The LV switchboard shall be provided with components as specified in these specifications, mentioned in the Bill of Quantities, as shown on the Tender Drawings required for the satisfactory operation of the switchboard and of the electrical system.

Typical component specifications are given below:-

4.1.2.1 **Bus Bars**

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on bus bars and these shall be red, yellow and blue for phases and white for neutral. The earth bus bar shall be green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

4.1.2.2 **Moulded Case Circuit Breaker (MCCB)**

The MCCB shall be moulded case, triple pole, rated for 415 Volt AC. The Operating current ratings and Rupturing capacities shall be as mentioned in the relevant items of the Bill of Quantities and as shown on the drawings. The MCCBs shall have fixed Magnetic Short circuit and fixed Thermal Overload protections. All incoming Triple pole circuit breakers shall be MCCBs.

The Moulded Case Circuit Breakers shall be installed in the LV switchboards such that the Switching levers of Main Incoming MCCB and all outgoing MCCBs and MCBs shall be accessible from inside the front of the panel with the front door in closed position. Circuit numbers and designation on all circuits shall be clearly marked to facilitate connection and maintenance.

4.1.2.3 **Miniature Circuit Breaker (MCB)**

The MCBs shall be Single pole 250 Volt and Triple pole 415 Volt of current ratings as shown on the drawings. These shall have fixed magnetic short circuit and fixed thermal overload protections. The Single pole and Triple pole miniature circuit breakers shall have a 10,000

Amperes short circuit breaking capacity as per International standards IEC 157 Category P2.

The Miniature Circuit Breakers shall be installed such that their switching levers are accessible through the front plate inside the switchboards for operations. Circuit Numbers and Designation on all circuits shall be clearly marked to facilitate connection and maintenance. These Circuit Breakers shall be suitable for working on lighting and power circuits.

4.1.2.4 **Air Break Magnetic Contactors**

The contactors shall be air break, triple pole, 415 Volt suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with 230 Volt, AC single phase operating coil, and minimum two normally open (NO) and two normally closed (NC) auxiliary contacts wired upto terminals. The number of working auxiliary contacts shall be provided according to the system requirements.

4.1.2.5 **Push Buttons**

Push buttons shall be momentary make break contact type (normally open/normally close). These shall be suitable for flush mounting on switchboard, plastic faceplate etc. Push buttons shall have round/square head. These shall be of red color for 'ON' and green color for 'OFF' operations.

4.1.2.6 **AC Voltmeters**

AC Voltmeters shall be digital type and shall be suitable for flush mounting on front door of the switchboards. The front dimensions shall be 96 mm Wide and 48 mm high. The voltmeters shall have 3-1/2 digit, 0.55-inch display. The AC digital voltmeters shall have measuring range of 0 to 1999 Volt AC. It shall be suitable for power supply of 110/220 Volt AC $\pm 10\%$ at 50/60 HZ.

4.1.2.7 **Ammeters**

AC Ammeters shall be digital type and shall be suitable for flush mounting on front door of the switchboards. The front dimensions shall be 96 mm wide and 48 mm high. The Ampere meters shall have 3-1/2 digit, 0.55-inch display. The AC digital voltmeters shall have measuring ranges as shown on the drawing and given in the Bill of Quantities. It shall be suitable for power supply of 110/220 Volt AC $\pm 10\%$ at 50/60 Hz.

4.1.2.8 Voltmeter Selector Switch

The voltmeter selector switch shall be complete with front plate, grip handle, and RY-YB-BR-OFF-RN positions.

4.1.2.9 Ampere meter Selector Switch

The ampere meter selector switch shall be complete with front plate, grip handle, and R-Y-B-OFF positions.

4.1.2.10 Indicating Lamps

Indicating lamps shall be suitable for flush mounting, complete with base, 230-Volt neon lamp and shall have rosettes of suitable colour.

4.1.2.11 Current Transformers

Air-cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 and have 5 amps secondary.

4.1.2.12 Line up Terminals

Line up terminals wherever provided for control of lighting, power and control circuits shall be suitable for voltage and size of conductors as indicated on drawings and as mentioned in the respective BOQ items. The line-up terminals shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

4.2 Low Voltage (415 Volt) Bus Tie Duct

4.2.1 Sheet Metal Work

The complete enclosures for the LV (415 Volt) Bus Tie Duct shall be fabricated with 14 SWG sheet steel.

The complete sheet steel metal work of the LV (415 Volt) Bus Tie Duct shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint.
- Two coats of weather proof powder paint in approved colour.

4.2.2 Components

The LV Bus Tie Duct shall be provided with components as specified in these specifications, mentioned in the Bill of Quantities, as shown on the Tender Drawings required for the satisfactory operation of the Bus Tie Duct and of the electrical system.

Typical component specifications are given below:-

4.2.2.1 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on bus bars and these shall be red, yellow and blue for phases and white for neutral. The earth bus bar shall be painted green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

4.2.2.2 Insulators

The insulators for mounting of Busbars shall be suitable for 3 phase, 4 wire, 415 Volt AC operation as shown on the drawings.

4.2.2.3 Insulating supports

The insulating supports for mounting of busbars inside the sheet steel enclosure shall be of suitable material and thickness to provide the required insulation. These shall also be suitable to withstand the physical weights of the busbars.

4.2.2.4 Nuts, Bolts and Washers

The nuts, bolts and washers for the Bus Tie Duct shall be made of galvanized steel suitable for long life operation.

4.3 Power Factor Improvement (PFI) Plant

4.3.1 Sheet Metal Work

The complete enclosures for the Power Factor Improvement Plant shall be fabricated with 14 SWG sheet steel.

The complete sheet steel metal work of the Power Factor Improvement Plant shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint
- Two coats of weather proof powder paint in approved colour

4.3.2 Components

The Power Factor Improvement Plant shall be provided with components as specified in these specifications, mentioned in the Bill of Quantities, as shown on the Tender Drawings required for the satisfactory operation of the Power Factor Improvement Plant and of the electrical system.

Typical component specifications are given below:

4.3.2.1 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on bus bars and these shall be red, yellow and blue for phases and white for neutral. The earth bus bar shall be painted green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

4.3.2.2 Insulators

The insulators for mounting of busbars shall be suitable for 3 phase, 4 wire, 415 Volt AC operation as shown on the drawings.

4.3.2.3 Insulating supports

The insulating supports for mounting of busbars inside the sheet steel enclosure shall be of suitable material and thickness to provide the required insulation. These shall also be suitable to withstand the physical weights of the busbars.

4.3.2.4 **Nuts, Bolts and Washers**

The nuts, bolts and washers for the Bus Tie Duct shall be made of galvanized steel suitable for long life operation.

4.3.2.5 **Power Factor Regulator**

The Power Factor Regulator shall be suitable for sensing power factor in a Three Phase unbalanced load network. The Power Factor meter shall be digital. The regulator shall have provision for Automatic cum Manual operation. The operating voltage shall be same as that for the associated LV switchboard.

The Power Factor Regulator shall be microprocessor controlled for fast computer programming at site. It shall have provisions for sensing connection errors.

4.4 **Maintenance By-Pass Switch (MBS)**

4.4.1 **Sheet Metal Work**

The complete enclosures for the Maintenance By-Pass Switch shall be fabricated with 14 SWG sheet steel.

The complete sheet steel metal work of the Maintenance By-Pass Switch shall be:

- cleaned down to bare shining metal
- de-rusted and de-greased
- painted with two base coats of anti-corrosive RED oxide paint
- Two coats of powder paint in approved colour

4.4.2 **Components**

The Maintenance By-Pass Switch shall be provided with components as specified in these specifications, mentioned in the Bill of Quantities, as shown on the Tender Drawings required for the satisfactory operation of the Maintenance By-Pass Switch and of the electrical system.

Typical component specifications are given below:

4.4.2.1 **Bus Bars**

The bus bars shall be made of high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours

applied on bus bars and these shall be red, yellow and blue for phases and white for neutral. The earth bus bar shall be painted green.

The bus bars shall be triple pole and neutral and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 45 degrees centigrade at rated current.

4.4.2.2 Insulators

The insulators for mounting of Busbars shall be suitable for 3 phase, 4 wire, 415 Volt AC operation as shown on the drawings.

4.4.2.3 Insulating supports

The insulating supports for mounting of busbars inside the sheet steel enclosure shall be of suitable material and thickness to provide the required insulation. These shall also be suitable to withstand the physical weights of the busbars.

4.4.2.4 Nuts, Bolts and Washers

The nuts, bolts and washers for the Bus Tie Duct shall be made of galvanized steel suitable for long life operation.

4.4.2.5 Air Break Magnetic Contactors

The contactors shall be air break, triple pole, 415 Volt suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with 230 Volt AC single phase operating coil, and minimum two normally open (NO) and two normally closed (NC) auxiliary contacts wired upto terminals. The number of working auxiliary contacts shall be provided according to the system requirements.

4.4.2.6 AC Voltmeters

AC Voltmeters shall be digital type and shall be suitable for flush mounting on front door of the switchboards. The front dimensions shall be 96 mm Wide and 48 mm high. The voltmeters shall have 3-1/2 digit, 0.55-inch display. The AC digital voltmeters shall have measuring range of 0 to 1999 Volt AC. It shall be suitable for power supply of 110/220 Volt AC $\pm 10\%$ at 50/60 HZ.

4.4.2.7 Voltmeter Selector Switch

The voltmeter selector switch shall be complete with front plate, grip handle, and RY-YB-BR-OFF-RN positions.

4.4.2.8 Indicating Lamps

Indicating lamps shall be suitable for flush mounting, complete with base, 230-volt neon lamp and shall have rosettes of suitable colour.

4.4.2.9 Line up Terminals

Line up terminals wherever provided for control of lighting, power and control circuits shall be suitable for voltage and size of conductors as indicated on drawings and as mentioned in the respective BOQ items. The line-up terminals shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

5.0 INSTALLATION

5.1 Low Voltage (415 Volt) Switchboard

The location of LV switchboards is shown diagrammatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in coordination with other equipment.

LV switchboard for floor mounting shall be installed on already prepared CC cable trenches. The LV switchboards shall be protected to avoid any damage due to the civil work.

All loose parts dispatched separately with the switchboard shall be installed as per manufacturer instructions and all adjustments or setting shall be made as required. All screws, nuts and bolts used for fixing the switchboard shall be galvanized.

The switchboards installation shall include connecting all incoming and outgoing cables. The cable entry in the boards shall be provided from top or bottom as required.

The switchboard body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer. The LV switchboards shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

5.2 **Low Voltage (415 Volt) Bus Tie Duct (BTD)**

The Bus-Tie Duct shall be installed at the locations as shown on the drawings. All installation materials steel hangers brackets supports etc. as required and recommended by the manufacturer for safe erection shall be provided and installed by the Contractor without any additional cost. The bus tie duct shall be carefully aligned and all steel supports made of bolted connections using nuts bolts washers etc. shall be provided by the Contractor. All material and accessories shall be galvanized /rustproof. The section of copper bars of the bus tie duct requiring bolting together shall be thoroughly cleaned at site. A coat of conductive oxide inhibitor compound to be applied on the surface to be connected and the sections bolted together by means of torque wrenches using the bolts provided by the manufacturer. The bus tie duct shall be tested and commissioned in the presence of the Engineer or his representative at the manufacturer's works. After successful completion of tests the contractor shall furnish Test certificates. The bus tie duct shall be tested at site before energizing as per article "Testing" Section - 8001 of these Specifications.

5.3 **Power Factor Improvement (PFI) Plant**

The location of Power Factor Improvement Plant is shown diagrammatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in coordination with other equipment.

Power Factor Improvement Plant shall be installed on already prepared CC cable trenches. The Power Factor Improvement Plant shall be protected to avoid any damage due to the civil work.

All loose parts dispatched separately with the Power Factor Improvement Plant shall be installed as per manufacturer instructions and all adjustments or setting shall be made as required. All screws nuts and bolts used for fixing the Power Factor Improvement Plant shall be galvanized.

The Power Factor Improvement Plant body shall be connected to earth as per instructions given in section "Earthing" of these Specifications.

The Power Factor Improvement Plant shall be tested and commissioned in the presence of the Engineer. The Power Factor Improvement Plant shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

5.4 **Maintenance By-Pass Switch (MBS)**

The location of Maintenance By-Pass Switch is shown diagrammatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in coordination with other equipment.

Maintenance By-Pass Switch shall be installed on already prepared CC cable trenches. The Maintenance By-Pass Switch shall be protected to avoid any damage due to the civil work.

All loose parts dispatched separately with the Maintenance By-Pass Switch shall be installed as per manufacturer instructions and all adjustments or setting shall be made as required. All screws, nuts and bolts used for fixing the Maintenance By-Pass Switch shall be galvanized.

The Maintenance By-Pass Switch installation shall include connecting all incoming and outgoing cables.

The Maintenance By-Pass Switch body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The Maintenance By-Pass Switch shall be tested and commissioned in the presence of the Engineer. The Maintenance By-Pass Switch shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electrical Works (Section-8001).

6.0 **MEASUREMENT AND PAYMENT**

6.1 **General**

The Contractor's bid amount against each item of Bill of Quantities as given below shall include design, fabrication, supply, installation, testing, commissioning and completion for all works specified herein and/or as shown on the Tender Drawing related to the item.

6.2 **Low Voltage Switchboard**

6.2.1 **Measurement**

Measurement shall be made for the number of each type/designations of LV switchboards acceptably supplied, installed, tested and commissioned by the Contractor as a complete job.

6.2.2 **Payment**

Payment shall be made for the number of each type/designations of jobs measured, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the LV

switchboards, including fixing arrangement and accessories for complete installation.

6.3 Low Voltage Bus-Tie Duct

6.3.1 Measurement

Measurement shall be made for the running meters of each type of LV bus-tie duct acceptably supplied, installed, tested and commissioned by the Contractor as a complete unit.

6.3.2 Payment

Payment shall be made for the number of running meters of each type of units measured as provided above at the Contract unit prices each. The payment shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the LV Bus Tie Duct including all installation materials such as hangers, brackets, supports, nuts, bolts, washers, sheet steel covers, ECC etc.

6.4 Power Factor Improvement Plant

6.4.1 Measurement

Measurement shall be made for the number of each type/designations of Power Factor Improvement Plant acceptably supplied, installed, tested and commissioned by the Contractor as a complete job.

6.4.2 Payment

Payment shall be made for the number of each type/designations of jobs measured, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the Power Factor Improvement Plant, including fixing arrangement and accessories for complete installation.

6.5 Maintenance By-Pass Switch

6.5.1 Measurement

Measurement shall be made for the number of each type/designations of Maintenance By-Pass Switch acceptably supplied, installed, tested and commissioned by the Contractor as a complete job.

6.5.2 **Payment**

Payment shall be made for the number of each type/designations of jobs measured, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the Maintenance By-Pass Switch, including fixing arrangement and accessories for complete installation.

SECTION - 14

MISCELLANEOUS ITEMS

1.0 GENERAL

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories for Miscellaneous Items as specified herein and/or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact locations and positions of the Miscellaneous Items.

The Miscellaneous Items with accessories shall also comply with the General Specifications for Electrical Works Section - 1 and with other relevant provisions of the Tender Document and latest WAPDA Specifications.

The miscellaneous items as described in this section shall comply with other sections of these Specifications as applicable. No specific reference to any manufacturer has been made and the Contractor shall ensure that all the miscellaneous items be supplied/fabricated from the reputable manufacturers, who have already supplied/fabricated similar items.

2.0 APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this Section:

- BS 4934 - Safety requirements for electric fans and regulators
- BS 5060 - Performance of circulating fans and their regulators
- BS 4752 - Switchgear & controlgear for voltages upto 1000 volt
- IEC 60439 - Factory built assemblies of LV switchgear & controlgear

3.0 MATERIAL

3.01 MCB/MCCB Enclosed in Sheet Steel Box

The single pole 250 Volts miniature circuit breakers (MCB) and triple pole 500 Volts moulded case circuit breakers (MCCB) are used for supplying single phase/three phase power to the equipment shown on the Drawings and given in the Bill of Quantities.

The MCB/MCCB shall conform to the same specifications as given in section LV distribution boards of these specifications. It shall be installed in a 14 SWG sheet steel box of such a size which can easily

accommodate the MCCB and incoming/outgoing wires or cables. Sufficient numbers of PVC connectors shall also be provided inside the sheet steel box for terminating the earth continuity conductors and neutral wires. The front plate fixed on the sheet steel box shall be of sheet steel fixed with G.I. screws having an opening for operating the ON-OFF lever of MCB/MCCB.

3.02 Ceiling Fan

Ceiling fan shall be capacitor type, suitable for 250 Volt AC. The air displacement shall be 12,000 cfm for 56" (1422 mm) sweep and 10,000 cfm for 48" (1219 mm) sweep at maximum speed. The fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation.

The down rod of ceiling fans shall be appropriate length such that the ceiling fan motor and blades are minimum 12 inches below false ceiling.

3.03 Ceiling Hook for Fan

The fan hook shall be made of 16 mm diameter mild steel rod. It should be in the form of a loop about 75 mm long and about 50 mm wide. The rod should be bent to have at least 200 mm extension on both sides for tying to reinforcement steel of slab. The fan shall be deluxe model, of specified make.

3.04 Wall Bracket Fan

Fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation. The fan regulator shall be built-in type with high grade steel laminations and shall have five speed marks and one "OFF" mark. The fan shall be finished in white colour, matching the ceiling and shall be of specified make.

3.05 Exhaust Fans

Exhaust fans shall be of plastic body and blades. The 6" dia fans shall have circular frame suitable for fixing in window glass. It shall have a card control shutter. The 9" and 12" exhaust fans shall have square shaped plastic body and blades. It shall be suitable for installation in wall openings. The fan shall have a card switch for reversible operation.

4.0 INSTALLATION

4.01 General

The mounting heights of all the miscellaneous items are stated on the drawings or in general notes. In case the mounting height is not

mentioned, the instructions of the Engineer shall be obtained before fixing the item.

4.02 **MCB/MCCB Enclosed in Sheet Steel Box**

The miniature/moulded case circuit breakers (MCB/MCCB) shall be installed on 1.63 mm (16 SWG) thick sheet steel box with screws or some suitable arrangements as approved by Engineer. White face plate for sheet steel box shall be fixed by means of flat head galvanized screws sunk in the plastic plate so as to finish flush with the wall surface. The edges of the plate shall be chamfered.

4.03 **Ceiling Fan**

Fan hook shall be installed in the RCC ceiling and to the reinforcement before pouring of concrete. The installation of fan shall include fixing of blades, down-rod, clamp, canopy, including testing and commissioning.

The down rod shall be of required length having long threads and shall be provided with check nuts to secure it firmly with the clamp and with the body of the fan. A split pin shall be provided both at the fan body end and at the clamp for safety. Any scratches on the body of the fan or fan rod appearing during installation shall be cleaned and painted properly with the same quality paint as provided by the manufacturer.

Wiring between the ceiling rose and the fan terminals shall be three core 1.5 mm² PVC insulated, PVC sheathed flexible cable.

4.04 **Wall Bracket Fan**

Wall bracket fan shall be installed on wall at locations shown on the drawings as per manufacturer's recommendations. Wiring between wall fan point and fan shall be with 3 core 1.5 mm² PVC insulated, PVC sheathed flexible cable.

4.05 **Exhaust Fans**

The exhaust fans shall be installed in window glass or in wall openings as required.

5.0 **MEASUREMENT AND PAYMENT**

5.01 **General**

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein, as shown on the Tender Drawings and given in the Bill of Quantities related to the item.

5.02 MCB/MCCB Enclosed in Sheet Steel

5.02.1 Measurement

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

5.02.2 Payment

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each item including sheet steel outlet box, plate and accessories as required.

5.03 Ceiling Fans

5.03.1 Measurement

Measurement shall be made for each type of Ceiling fan & accessories acceptably supplied and installed by the Contractor as a complete unit.

5.03.2 Payment

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of Ceiling fans including mounting, accessories such as nuts, bolts, hooks, down rod of appropriate length etc. and wiring between ceiling rose and fan terminals complete in all respects.

5.04 Wall Bracket Fans

5.04.1 Measurement

Measurement shall be made for each type of wall Bracket fan & accessories acceptably supplied and installed by the Contractor as a complete unit.

5.04.2 Payment

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of wall Bracket fans including mounting, accessories such as nuts, bolts, hooks, etc. and wiring between ceiling rose and fan terminals complete in all respects.

5.05 Exhaust Fans

5.05.1 Measurement

Measurement shall be made for each type of Exhaust fan & accessories acceptably supplied and installed by the Contractor as a complete unit.

5.05.2 Payment

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of Exhaust fans including mounting, accessories such as nuts, bolts, etc. and wiring between ceiling rose and fan terminals complete in all respects.

LOW VOLTAGE DG SET & AUTO MAINS FAILURE/ STARTUP (AMF/ATS) PANEL

1.0 DESCRIPTION

The work under this section consists of supplying, installation, testing & commissioning of all material & accessories with three (03) years of maintenance and service of the complete Diesel Generators of Prime rating (at 50°C), duly to be established by the manufacturers derating curves, losses and efficiencies of the engine, alternator and DG Set) set including but not limited to power cables, Automatic Mains Transfer Switch/Automatic Main Failure Switch Panel, LV Switchgear, fuel tanks (including day and underground storage tanks), control panels, canopy, all accessories as specified here-in, and given in the Schedule of Prices.

The Diesel Generator (Prime rating) set shall be a standard design in accordance with the latest applicable International Standards of a reputed manufacturer, who shall have similar units in operations for similar applications and field conditions. The manufacturer shall also have adequate maintenance facilities in the vicinity of Project with mechanically qualified and experienced personnel trained for operation and on-site maintenance of the equipments & materials offered by the Manufacturer in his bid.

The DG set shall be of prime rated duty and suitable for indoor/ outdoor (as applicable) installation. It shall be capable for unbalanced loads up to 30% of actual load and for continuous part load operation. The set shall be capable of starting and operating at the rated output as per the climatic conditions (typical range given in the following table) and at an altitude of the site of installation (given level of the site of installation in meters above mean sea level). The power rating shown in the relevant section of Schedule of prices (bill of quantities) is the power rating required to be delivered to load by the diesel generator set after applying all de-rating factors relevant to the site.

The table below shows the ambient temperatures (see definition (1) and the relative humidity rates to which the equipment can be submitted according to the category they belong; the later may be stated by the particular specifications.

Climatic Conditions

Category	I		II		III	
Rated operating range (2)	T1: +15°C	T2: +30°C	T1: -5°C	T2: +45°C	T1: -25°C	T2: +55°C
Maximum operating limits (3)	T3: +5°C	T4: +40°C	T3: -10°C	T4: +60°C	T1: -15°C	T2: +60°C
Maximum relative humidity	75% at +23°C		80% at +23°C		100% at +45°C	
Operating location example	Air conditioned room		Non air conditioned room		Outdoor	

1. Ambient temperature (IEC 60441-02-06)
Temperature determined within specified conditions of the air which surrounds the whole equipment.
2. Rated operating range:
Range of values at which equipment performs within specifications.
3. Maximum operating limits:
Range of values at which equipment can still work without deterioration or degradation of its operating qualities.

The DG set ratings must be substantiated with manufacturer's standard published data. The Diesel Generator set after reducing the power absorbed by the auxiliaries, shall deliver rated power output under the site conditions. All auxiliaries, accessories and connections between systems along with all necessary cables, fittings, hardware, etc., for complete installation of Diesel engine, Generator, control panel, including fuel & oil storage, exhaust system, etc., shall be furnished by the manufacturer.

The engine shall be directly coupled to the generator, and shall have a rated speed of 1500 rpm. The set shall be capable of sustaining without damage, 25% over speed under any abnormal operating condition.

The engine-generator set shall be mounted on suitable rigid steel base frame with vibration isolators. Heavy duty lifting eyes and/or jacking screws shall be provided on the skid. The foundation bolts and all other material/hardware for complete installation of the set, as required, shall be furnished with the set. Any excessive torsional vibration shall be avoided for both engine and alternator. The set shall be suitable for full load starting. When the generator is operating at no-load, the application of full load current, taking into account the surge due to starting of equipment, should be possible with maximum transient voltage drop of 15% of the rated voltage. The time taken to restore the generator voltage to 97% of rated value should not exceed 1.5 seconds. The set shall be capable for starting and accepting full load within 15 seconds after receipt of starting signal. The Manufacturer shall submit the equipment layout and other installation details along with the bid.

The details and technical data concerning Diesel Generator set shall be submitted with tender bid. Where required the documents from the manufacturer shall be furnished in support of the information furnished.

The DG Sets shall be supplied from the manufacturers/authorized agents or firms duly eligible by the manufacturer for sales, services and after sales back up support system and facilities along with suitable full time operation and maintenance experience:

The alternator and engine shall be as follows:

Alternator Make/Brand:

Siemens, Newage/Stamford/Cummins, Lorrey-Sommer, Cater Pillar/ Olympian or approved equivalent.

Diesel Engine Make/Brand:

Volvo, Perkins, Cummins, Mitsubishi, John Deere, Cater Pillar or approved equivalent.

Operating Console:

DeepSea, Power Wizard, APM, Intli Compact, DataCom or equivalent

2.0 APPLICABLE STANDARDS/CODES

The Diesel Engine and Generator set shall conform to the following standards as applicable.

- | | |
|---------------------|---|
| ISO3046 | - (Reciprocating internal combustion engines) |
| BS 4999 | - General Requirements for Rotating Electrical Machines. |
| DIN EN 12285-2;2005 | - Horizontal Steel Tanks for the Storage above Ground of Petroleum Products in Liquid Form. |

For other equipment and materials related to the Diesel Generator set, the Manufacturer shall follow relevant international standards.

3.0 MATERIAL REQUIREMENTS

3.1 Diesel Engine

3.1.1 General

The Diesel Engine shall be four strokes, compression ignition, suitable for Emergency supply duty. Starting shall be through motor operated electric starter. The engine shall be equipped with an alternator type automatic charging system to charge the batteries during running of engine. The engine shall be provided with required auxiliaries, guarantees of fuel consumption, acceptance tests, torsional vibration characteristics.

3.1.2 Air Intake

Air intake shall be through turbo charger and equipped with dry type filter. Suitable attenuators shall be installed to reduce noise at the air inlet. The filter assembly shall be constructed of non-corrosive materials.

3.1.3 Engine Cooling

Engine shall have a forced air draft, water cooled radiator supplied with a core guard. Cooling system shall have an engine driven centrifugal pump for cooling water circulation. Cooling shall be thermostatically controlled. An engine shut down timer shall be provided to keep the engine running on no-load after any operation of set, so that the engine is sufficiently cooled to start again instantly, if required, without rise in temperature above safe limits. The radiator shall be designed to cool the engine at specified output in ambient temperature upto maximum value. Radiator flexible ducting, flange and all necessary ductwork, flexible connections, fittings and supports shall be supplied to extend from the radiator to the exhausts louvers so that hot air from the radiator escapes freely to the outside of the building.

3.1.4 Engine Lubrication

A gear type positive pressure lubrication pump shall be provided with efficient filtration arrangement for the lubrication system. A 230Volt AC mains-operated heater with thermostat shall be provided in the crankcase. The heater shall be designed for automatic switching to ensure that temperature of oil is maintained for proper operation of the engine.

3.1.5 Speed Governor

The speed governor shall be electronic or digital complying with the requirements BS ISO 3046 or latest applicable international standard. Governor shall regulate engine speed so as to maintain the generator frequency within $\pm 2\%$ of the rated frequency. Stable engine speed shall be attained within 15 seconds after the engine has been started.

Stable engine speed shall be restored within 10 seconds of any sudden change in load, from no load to full load. During this change of load or surge, the speed shall not vary by more than $\pm 5\%$ of the rated speed. Means shall be provided on the engine to shut down the engine automatically in the event that the engine speed exceeds the "shutdown" speed.

3.1.6 **Fuel System**

Engine shall operate on Commercial High-Speed Diesel oil. A fuel oil strainer/filter shall be provided in the fuel line along with a water separator. Fuel system for Diesel engine shall not require any priming. The fuel system shall comprise;

- Fuel storage tank(s)
- Day Tanks
- Fuel transfer pumps
- Piping

The fuel day tank shall have capacity to store fuel oil for twelve (12) hours continuous operation of the set at the rated output. The tank shall have level switch for monitoring low fuel level in the tank. The low-level switch shall provide an annunciation and prevent starting of set and to stop the set when the fuel in day tank is at this level. The tank shall be provided with overflow, vent, supply and discharge valves, inspection cover, drain valve and glass sight gauge.

The fuel day tank shall be designed, fabricated and finished in accordance with the requirements of DIN EN 12285-2;2005 - Horizontal Steel Tanks for the Above Ground Storage of Petroleum Products in Liquid Form. The fuel day tank shall be incorporated in the steel base frame of the DG set. The structural steelwork shall be protected from corrosion.

The fuel piping to be furnished shall include fuel supply pipe from tank to the set, over flow pipe from the set to the tank, level indicator, fuel cap with breather, drain pipe from the tank.

Drain Line: The day tank drain tank shall be accessible and equipped with a shut off valve. Self supporting day tank shall be arranged to allow drainage into a 305mm high bucket. The local fuel fill port on the day tank shall be provided with a screw on cap.

3.1.7 **Main Fuel/Bulk Tank (Underground)**

The contractor shall supply and install underground cylindrical diesel storage tanks with a capacity to operate the associated diesel generator(s) continuously on full load for 3 complete days.

The Tank shall be of welded mild steel construction suitably protected from corrosion in accordance with DIN EN 12285-1; 2003 & DIN EN 12285-2;2005 and shall be installed in the location indicated in the drawings. The underground enclosure to be made of suitably reinforced concrete.

The storage tanks shall be complete with pumps, pipes, fittings, feed

lines, etc. They shall have a 600mm inspection manhole cover, 50mm filling pipe with cooped filling terminal, 50mm air vent pipe with screen outlets, isolating valve, valve drain etc.

Electronic fuel indicator with an audio/visual alarm shall be provided. The storage tank must comply with Relevant Standards for generator operation. All piping to be designed, constructed and tested in accordance with ASME B31.1.

Diesel Oil Pumping Set: Provide two package type fuel oil pumping and straining sets with a capacity of four Times the total fuel consumption of the engine at full load. Pumps shall be factory assembled, piped, wired and tested. Pumps shall be activated automatically by a switch in the day tank.

Piping shall be complete for suction, discharge and return line connections. Provide gate valves and unions arranged to permit removal of pumps while the system is in operation. Install check valves and relief valves on pumps outlet and gate valves prior to pressure gauges.

Suction strainer shall be flanged connection type, one piece, cast iron body and ASTM A48 class 30, with 1.2 mm perforation brass baskets. Oil pump shall be factory assembled on structural steel channel beam base to include pump motor, flexible coupling and guards. Pump shall be suitable for diesel oil. Suitable manually operated fuel pump shall also be provided.

3.1.8 Radiator Exhaust Duct

The radiator exhaust duct shall provided for exhaust of hot air through DG set radiator. The radiator exhaust shall be designed and routed in such a way so as to give minimum resistance to airflow.

3.1.9 Exhaust System

Exhaust system shall be equipped with a **HEAVY DUTY RESIDENTIAL** type silencer complete with muffler, exhaust manifold, flexible connector, exhaust elbow, exhaust pipe, rain cap, and associated fittings. This exhaust line shall be adequately covered with insulation material over its entire length i.e. from the engine to the termination point at rain cap. All supports for exhaust system shall be furnished. Hangs and supports shall be provided for the silencer such that essentially no load is transmitted to the engine.

3.1.10 Battery

Heavy-duty maintenance free lead acid batteries shall be provided with the set and mounted on the skid. The fully charged batteries shall be furnished with the set and connected with the help of heavy duty interconnecting cables.

The batteries shall be of adequate ampere-hour rating/capacity to satisfy the following requirements:-

- a. Crank the engine at firing speed for at least 15 seconds.

- b. If the engine does not start on the first attempt, crank the engine two more times for the above duration at an interval of 30 seconds between each cranking operation.

3.2 Alternator

3.2.1 General

The alternator shall be synchronous. The alternator shall be capable of carrying, continuously 10% over load of rated output with the field set for normal rated load excitation for 1 hour in every 12 hours operation.

The alternator shall be rated as follows:

Capacity	:	As stated in BoQ
Voltage	:	400/230 V
Phases	:	3Phase, 4 wire, grounded neutral
Frequency	:	50 Hz
Power Factor	:	0.8 lagging

3.2.2 Excitation

Excitation shall be from brushless rotating diodes mounted on the main shaft for 3-phase full wave rectification.

3.2.3 Windings

Alternator windings shall have Class H insulation and shall be impregnated for tropical use. The temperature rise of winding under normal operating conditions and at rated load shall not exceed the limits specified for Class-B insulation. Anti-condensate heaters shall be provided for windings. The heaters shall be thermostatically controlled for switching **ON** after the set has stopped. The thermostat range shall be adjustable and set to prevent overheating of windings. For protection of windings from damage due to overheating, thermistors shall be embedded to stop the set in case the temperature of winding rises above the safe value.

3.2.4 Deviation Factor

The deviation factor of the open-circuit line to line terminal voltage shall not exceed 0.10.

3.2.5 Voltage Regulation

Voltage regulator shall be solid state with provision for manual setting. Regulator shall be so designed to protect the exciter when the set is running at reduced speed during starting or idling of the prime mover. Voltage regulation shall be $\pm 2.5\%$ from no-load to full load. Transient voltage drop shall be less than 15% at full load and 0.8 power factor. Time required to restore to steady state conditions after transient voltage fluctuation shall not exceed 10sec.

3.2.6 **Short Circuit Capability**

Generator shall be capable of withstanding without injury, a 30 seconds three phase short circuit at its terminals when operating at rated output and power factor with fixed excitation.

3.2.7 **Temperature Rise**

Alternator temperature rises at continuous rating in an ambient of 52 degree C shall not exceed 70 degree C by resistance measurement on the field. The exciter temperature rise shall not exceed 52 degree C by resistance measurement on field or armature when the main generator is on continuous rating.

3.2.8 **Vibration and Balance**

The vibration level of the alternator when coupled to the engine shall not exceed the ISO Specifications or equivalent.

3.2.9 **Bearings**

The bearings shall preferably be grease lubricated and anti-friction type and shall be selected to provide for long trouble free service.

3.3 **Indication/Metering Panels**

3.3.1 **General**

The indication/metering panel shall be designed for front access, completely assembled, wired and tested. The control panels shall conform to the constructional requirements as per international standards and norms.

The panel shall incorporate protection and control equipment, measuring instruments, control and instrument transformers, voltage regulator, governor controls, battery charger, indicating lamps, etc. Engraved nameplates of stainless steel shall be provided on all panels for clearly identifying panels and devices mounted inside of panels. Standard nameplate with black lettering shall be provided.

Cables and capillary tubing shall be tagged with a neoprene disc or approved equivalent, stamped with the cable number or tube function for easy identification.

3.3.2 **Moulded Case Circuit Breakers**

The Four pole moulded circuit breaker shall be provided with the set. The circuit breaker shall have the Thermal over current and short circuit releases as below:

$$\begin{array}{lll} I_{th} & = & 60 \text{ to } 100\% \text{ of Current rating} \\ I_{sc} & = & 50 \text{ kA (min)} \end{array}$$

The circuit breaker shall be mounted in a vibration isolated sheet steel box with adequate access for incoming and out going cables.

3.3.3 Magnetic Contactors

The contactors shall be four pole, 400 V AC duty cycle-3. The main contacts shall be silver tipped, but type with double break per pole. Each contactor shall be provided with 230V AC single phase operating coil, and minimum two normally open and two normally closed auxiliary contacts wired up to terminals. But if more number of working auxiliary contacts are required then, these shall be provided according to the system requirements.

3.3.4 Battery Charger

Multi stage intelligent (Digital Microprocessor based with a communication port RS 485) high efficiency battery charger with automatic charging stage selection, capable of charging of a wide range of batteries, when engine is not running. The charger shall be fully capable to recharge a completely discharge battery within four hours at boost/maximum charge. The charger shall be of constant voltage and constant current with maximum current been drawn during charge recovery phase. The charger should automatically return to float/trickle mode when charging is complete.

The charger should have following safety features:

- Input under voltage protection
- Input over voltage protection
- Battery charge over voltage protection
- Battery output over current protection
- Short Circuit protection
- Battery temperature compensation with over temperature protection
- Reverse Polarity protection
- Automatic power derating at high ambient temperatures

Applicable Standards for Battery Charger:

- BS EN 61000 (Electromagnetic compatibility)
- BS EN 60950 (Electrical safety)
- BS EN 60068 (Temperature, Vibration, Humidity and Shock)
- BS EN 60529 (degree of Protection)

3.3.5 Instruments and Controls

- i. Ammeter (measuring as required)
- ii. Ammeter Phase selector switch
- iii. Voltmeter (0-500 volt AC)
- iv. Voltmeter phase selector switch
- v. Frequency meter
- vi. Start / stop key switch
- vii. Battery condition voltmeter
- viii. DC Voltmeter for batteries
- viii. Tachometer for Engine speed in Revolutions Per Minute (RPM)

- ix. Lube oil pressure in PSI
- x Lube oil temperature in Degrees Celsius
- xi. Engine water temperature in Degrees Celsius
- xii. Engine operation/ running time in hours

3.5 Safety Devices

3.5.1 Following safety devices shall be provided. The audible alarm shall operate on any fault condition and shall be resetable manually and automatically through a timer after 15 minutes whichever is earlier:

		A = Alarm	SD = Shutdown	TD = Adjustable Time Delay
i)	Engine Over speed	A	SD	
ii)	Low lube oil pressure	A	SD	
iii)	High water temperature	A	SD	
iv)	Over voltage	A	SD	TD (0-30 Sec.)
v)	Under voltage	A		
vi)	Short circuit and tripping of circuit breaker.	A	SD	TD (0-1 min.)
vii)	Low level in fuel storage tank	A	SD	TD (0-5 min.)
viii)	Winding temperature high	A	SD	TD (0-2 min.)
ix)	Over crank	A	SD	(After THREE Successive crankings)
x)	Low crankcase oil level	A		
xi)	High crankcase oil level	A		
xii)	Charging alternator failure	A		
xiii)	Charger failure	A		

For all shut down conditions, the set shall lockout and it shall not be possible to re-start it unless manually reset after the cause of fault has been removed.

3.5.2 Generator Electrical Protections:

Following electrical protections shall be provided in the generator:

1. High AC voltage shutdown	12. Reverse Power shutdown
2. Low AC voltage shutdown	13. Reverse VAR shutdown
3. Over frequency shutdown:	14. Under voltage shutdown:
4. Under frequency shutdown/warning	15. Over voltage shutdown:
5. Over Current warning/Shutdown:	16. Low and high battery voltage warning
6. Loss of sensing voltage shutdown	17. Weak battery warning
7. Field overload shutdown	18. Fail to start (over crank) shutdown
8. Over load (kW) warning	19. Reverse power protection
9. Short circuit protection:	20. Smart starting system
10. Digital Voltage Regulator	21. Battery monitoring system
11. PMG Excitation	

3.6 Auto-Mains Failure/Transfer (AMF/ATS) Panel

The AMF/ATS shall be floor mounted front access, completely assembled, wired and tested. The control panel shall conform to the constructional requirements as stated in these specifications for LV switch boards.

The AMF/ATS shall incorporate automatic changeover system, which will be designed for the following functions:

- a) To start the set immediately when the main supply fails
- b) To start the set within the 0 to 1 minutes (adjustable) whenever the main supply voltage drops to 360 volts or rise to 440 volts. The setting voltages shall be adjusted within -5 % and + 5% respectively for the lower & upper ranges.
- c) To transfer the load from Generator to main supply whenever the main system voltage returns between 90% to 110% of its rated value and persists for at least 3 minutes.
- d) To make two successive attempts, in case the set fails to start in the first and second attempt.
- e) The system shall provide for immediate transfer of load to the generator, after the rated speed and voltage have been achieved. The Generator should start immediately when the main supply fails
- f) The system shall be self resetting after each cycle of operation. To start the set immediately when the main supply fails
- g) Two normally open potentially free contacts shall be provided which shall close when the set is started with the operation mode selector switch in auto or manual position. The contacts shall be wired upto the terminals block in control panel.
- h) A four position selector switch shall be provided for selecting the operation mode i.e. Automatic-Manual-Test-stop/ Maintenance mode to facilitate the following operation:-
 - i) **Automatic**
As described in a to d.
 - ii) **Manual**

Manual starting of the set and load transfer from normal to standby and vice versa.
 - iii) **Test**

Testing the changeover operation when so desired and also for starting and running the set without interrupting the normal operation. In case of failure of main supply, the set shall automatically revert to automatic mode of operation.
 - iv) **Stop/Maintenance**

Provision shall be made to isolate the system for trouble shooting and maintenance without interruption of mains power supply. The set shall not be capable of starting in this condition.

3.7 Terminal Blocks and Terminals

Terminal blocks for control wiring shall be General Electric Type Eb stud terminal blocks or approved equivalent. Terminal studs and wires shall be numbered or otherwise marked in accordance with the applicable schematic and wiring diagrams.

Terminal blocks shall be arranged with sufficient room for each connection of incoming cables. Parallel rows of terminal blocks shall be spaced at least 150mm (6") apart.

Blocks shall be mounted in vertical columns along the sides of cubicles or on vertical panels specially provided for terminal blocks. 20% spare blocks distributed over the columns of terminal blocks shall be provided.

Terminals shall be suitable for screw terminals and shall be sized according to the wire being terminated.

Provisions shall be made to terminate and ground the overall copper shields of all incoming cables by a suitable method approved by the Engineer.

3.8 Component Wiring

All internal wiring shall be in accordance with IEC or VDE Standards with annealed copper conductor, thermo-plastic insulated with an overall flame-retardant braid. Wire sizes for control wiring in no case shall be smaller than 2.5 mm². The wire ends shall be permanently fitted with compression type connectors before attaching to terminal studs.

Wiring between terminals of various devices shall be point to point. All internal wiring shall be neatly trunked in wiring troughs bound and anchored.

All groups of bundled conductors to hinged doors and panels shall use extra-flexible wire arranged so that a twisting rather than a bending motion is imparted to the moving conductor bundle. Each bundle shall be anchored to the fixed member at the opposite end of the hinge axis to the anchoring point on the moving member so that the moving bundle length is the maximum available without loops.

All wires shall be identified at both ends according to the schematic diagram.

4.0 SPECIFICATIONS OF FUEL TANK, WEATHER PROOF, SOUND ATTENUATED CANOPY AND FOUNDATION PAD

4.1 Fuel Tank for 24 Hours of Operation

Supply & Installation of backup fuel storage tank of 10,000 litres, complete with filling cap, vent & suction pipe, minimum 5mm thick, MS sheet and inspection man hole complete in all respect. The dimensions and shape of the underground fuel tank shall be finalized as per site conditions. The Contractor shall coordinate with the client in this regard prior to finalization of the same.

4.2 Weather Proof and Sound Attenuated Canopy

Sound and weather proof canopy suitable for the Diesel Generating sets. The

canopy shall attenuate the sound level to below 85dB at a distance of 1 meter or less than 75dB at a distance of 3 meters from it. Textured insulation materials, Comprising of fire retardant resin, organic glass/rock fiber to ensure uniform long lasting absorption of sound. The canopy shall be constructed with weather proof corrosion resistant material and shall be modular in design. All sheet components pre-treated with cold fast prior to powder coating. All gas kits/joints be of Edpm (**ethylene propylene diene monomer** (M-class) rubber). The canopy shall be suitable for tropical climates.

- a) The enclosure shall allow easy access to the engine, alternator, and radiator filler cap, lube oil filling, filter replacement and control cubicle for easy maintenance purposes.
- b) Hinged and lockable doors all around canopy for easy access to D.G. set for routine maintenance and major over hauling.
- c) At least 1 foot clearance between the DG Set and Canopy shall be maintained from sites/directions.
- d) The enclosure shall be designed to be water and weather- proof.
- e) The intake area for air must be 1.8 times the size of radiator.
- f) The enclosure base frame should be designed with supports for easy transferred using forklift and crane.
- g) Canopy shall be capable of anti-corrosion to withstand high humidity.
- h) Proper grouting of both generator and canopy.
- i) The thickness of sheet for canopy body must be 4mm (minimum) whereas thickness of and door sheet 2mm (minimum).
- j) Glass wool will be of pure fiber.
- k) The canvas is to be place between radiator and the canopy that can be easily removed during troubleshooting.
- l) GENSET control panel should be visible from outside the canopy by means of plan glass.
- m) 4 Nos. Canopy lifting eyes arrangement from top of canopy.
- n) Sufficient air intake through Acoustic Louvers from both side & control panel side.
- o) Duly painted with good quality water proof and weather proof paint. Painted with 2 coats of zinc oxide primer and finishing with 2 coats of Syntactic Enamel (Burger/ICI) paint.

4.3 **Foundation Pad for DG Set**

- a) Fabrication of RCC Foundation suitable for genset operating weight complete in all respects, foundation to be made according to generator size and should have all required sleeves for piping, conduiting etc. as per specifications.

- b) The pad should be at least 12 inches (300mm) height from and extend at least 6 inches (150 mm) beyond the skid on all sides.
- c) The weigh (W) of the foundation should be at least 2 times (and up to 5-10 times) the weight of the set itself to resist dynamic loading. (The weight of fuel in a sub-base fuel tank should not be considered to be contributing to the weight required of a vibration isolating foundation even through the isolators are between the tank and the generator set).
- d) The foundation should extend at least 6 inches (150mm) beyond the skid on all sides. This determines the length (l) and width (w) of the foundation.
- e) The foundation should be reinforced concrete with a 28-days compressive strength of at least 3000 psi

4.4 Tests:

4.4.1 General

The set furnished by the Contractor under this Contract shall be subject to tests in the shop and at site in the presence of the Engineer for conformity to requirements of the Specifications.

4.4.2 Diesel Engine

All mechanical parts shall be run under simulated operating conditions at the Manufacturer's works.

All tests shall be conducted in accordance with the appropriate codes for testing. The tests to be carried out shall include, but not be limited to, the following:

- i) Dynamic balancing together with over speed tests of the generator exciter and rectifiers.
- ii) Bench testing of all accessories.
- iii) Zero load operation of the diesel engine assemblies to test the following:
 - Vibration.
 - Lubricating system.
 - Fuel system.
 - Governor system.
 - Temperature control system.
 - Over speed trip.
 - Individual accessories.

The diesel engine and AC generator shall be test-run continuously for 24 hours to ensure smooth running and satisfactory operation of the machines and accessories. The above tests will be witnessed by the Engineer.

The contractor shall state in his proposal the performance and reliability tests to be carried out in the Works.

Tests on the unit shall not be less than the minimum requirements of ISO standard Practices for equipment.

4.5 Generator

4.5.1 General

The set furnished by the Contractor under this Contract shall be subject to tests in the shop and at site in the presence of the Engineer for conformity to requirements of the Specifications.

4.5.2 Routine Tests

Routine tests on the generator shall be performed at the manufacturing works/workshop of the DG Set manufacturer/Supplier. Routine tests shall include:

- a) Resistance of armature and field windings
- b) Polarity of field coils
- c) Check of mechanical balance
- d) Check of no-load field current or exciter field current
- e) Voltage balance
- f) Phase sequence
- g) No-load saturation curve
- h) Insulation and high potential tests
- i) Over speed test at 125% speed for 1 minute
- j) Load Tests (24 hours)
 - 1. Continuous thirty minutes heat run at 25 percent load rating
 - 2. Continuous three hour heat run at 50 percent load rating
 - 3. Continuous eight hour heat run at 75 percent load rating
 - 4. Continuous twelve hour heat run at 100 percent load rating
 - 5. Continuous thirty minutes heat run at 110 percent load rating

Fuel, water and electric power required for "Performance Tests" shall be provided by the Contractor

Where the generator is not completely assembled in the factory, tests (d) to (i) above inclusive may be carried out with the generator coupled to Engine Test (a) to (d) shall also apply to the exciter.

4.5.3 Type Tests

The generator shall have the following tests performed:

- a) Short circuit saturation curve.
- b) Temperature test.
- c) Segregated losses.
- d) Voltage deviation factor.
- e) Three phase line to line short circuit test at any convenient voltage in the 0.4 to 0.5 p.u. volts.

4.5.4 Characteristics Test Curves

Following completion of type tests, Manufacturer shall provide characteristics curves of the brushless excitation system. These curves shall show:

- a) Exciter field amps and volts versus generator line current at 0.80 Pf. and maximum and minimum temperature rises.
- b) Exciter field amps and volts versus generator line current at 1.0 Pf and maximum and minimum temperature rises.
- c) As for (a) above, but with one diode failed.

The above six curves shall be plotted from no-load to maximum rated load at rated generator voltage. Following approval of curves by the Engineer, they shall be incorporated by the Manufacturer into the Emergency Diesel Generating Set Maintenance Manual.

4.5.5 Performance Tests

At the conclusion of installation of the Emergency Diesel Generating Set at site, commissioning tests shall be carried out by the Contractor/Manufacturer to demonstrate the satisfactory operation of the equipment and to verify the guaranteed performance figures of the diesel unit. The tests shall comprises:

- 1. Preliminary tests on individual components.
- 2. Continuous one-hour heat run at 50 percent load rating in parallel with the system.
- 3. Continuous one-hour heat run at 75 percent load rating in parallel with the system.
- 4. Continuous four-hour heat run at 100 percent load rating in parallel with the system.
- 5. Part load heat runs to demonstrate satisfactory operation and establish fuel consumption at the respective loads.
- 6. The tests shall also include:
 - a) Performance of Governing characteristics and protective systems.
 - b) Starting characteristics of the units. The units shall start at least five (5) times in six (6) consecutive starting attempts.
 - c) Starting power requirements to demonstrate the ability

of the machine to start the specified number of times without need to recharge the batteries.

The instrumentation supplied as standard with the equipment will be used during the commissioning tests for measurement of voltage, frequency, temperatures, pressures, etc. normally recorded during commercial operation. Additional instruments required for the measurement of electrical output, fuel flow, vibrations, etc. shall, at no extra charge, be provided by the Contractor.

Tests to be carried out manufacturer's work and at the site shall be to the satisfaction of the Engineer. Seven copies of test certificates shall be forwarded to the Engineer immediately following each test. The site test report shall include a list of final settings and adjustments carried out during commissioning.

If the tests show that the set does not reasonably comply with Bid, the Contractor/Manufacturer shall, at his own expense, make all necessary corrections to the unit. Additional tests shall then be made to demonstrate the effectiveness of these corrections. Until the necessary corrections have been made, the conditions of the contract shall not be considered fulfilled.

Fuel, water and electric power required for "Performance Tests" shall be provided by the Contractor.

Seven (7) copies of the Final Performance Test Report shall be submitted to the Engineer not later than one (1) month after completion of the performance tests.

4.6 Diesel Generator Set

4.6.1 Measurement

Measurement shall be made for one No. of diesel generator set 1000 kVA Prime rating alongwith all its allied accessories acceptably supplied and installed by the Contractor as a complete job.

4.6.2 Payment

Payment shall be made for one No. of DG Set alongwith all its allied accessories, as provided above, at the Contract unit price each for design, fabricating, supplying, installing, testing, and commissioning of the of diesel generator set (1000kVA (Prime rating), including fixing arrangement and accessories for complete installation.

4.7 Generator Services & Maintenance

4.7.1 Scope of Service

- a) Scope of work shall include but not limited to maintenance and support services to ensure smooth, uninterrupted and trouble free operation of each of generators for ensuring round the clock availability of rated electric power supply to all stations and that the

services shall therefore include all services (Routine Preventive Maintenance, Corrective Maintenance and Repairs. conformity of specifications & the satisfaction of Client/Operating Agency/body.

- b) The contractor shall allocate necessary resources and expertise to provide the said top quality services and undertake to provide services of highest industry standards, to the satisfaction of Client/Operating Agency/body.
- c) Scope includes inspection of installed DG sets by experts Engineer and Technicians and replacement of spares on need basis. The expert team available to fix the problem within specified time related to DG sets around the clock on call basis. Expert team available for all types of technical consultation on maintenance, modification, upgrading of DG sets, selection and procurement of spare parts etc on cost basis as agreed upon by the parties.
- e) Regardless of the time of the day /night when the matter is reported, Contractor shall ensure that our technicians and engineers shall remain engaged in the rectification of the problem until the operation of the generator(s) is restored to the satisfaction of the Company.
- f) Contractor shall maintain an inventory of parts required for maintenance of the generators and to make replacements of all faulty parts, whether in case of an emergency or during routine visits, from its own stock at the earliest in accordance with frame agreement.
- g) Contractor shall ensure that new, unused, genuine and best quality spare parts shall be used while carrying out services including emergency services and preventive maintenance

Contractor shall ensure 'Routine Maintenance' and 'Emergency on Call' teams in Lahore for this particular project.

4.7.2 Criteria for Preventive Maintenance (PM):

4.7.2.1 Schedule of Preventive Maintenance is divided into 2 parts

- a) Monthly Schedule (Preventative Maintenance)
- b) As & when Required (Emergency Preventive Maintenance)

4.7.2.2 Guidelines for selection criteria for selecting Genset for preventive maintenance will be following;

- a) Gensets exceeding running hours nearing or at 300 hrs.
- b) Consumables replacement during PM will be initiated by Genset operator, in which requirement of consumables to be changed will be explicitly mentioned.
- c) Following guidelines & rational shall be used for initiating replacement of consumables:
 - i) Change of Lube oil. i.e. Complete oil will be drained & change with fresh oil.
 - ii) Change of Oil Filter.

- iii) Change of Fuel Filter will be subjected to physical condition of fuel filter.
- iv) Change of Air Filter will be subjected to the physical condition/ exceeding 600 running hours since last maintenance.

4.7.2.3 FSR (Field Service Record) Verification Procedures for Gensets PM & CM

- a) Contractor shall provide FSR (Field Service Record) to Client/Operating Agency/body within 48 hours of execution of an activity on site.
- b) Detail for all Preventive Maintenance work will mentioned on FSR against all PM site visits.

4.7.3 Preventive Maintenance Scope of Work for Generators

4.7.3.1 General

- Check tightness of all Exhaust connections.
- Check engine mountings.
- Lubricate all points with grease/oil.
- Remove all necessary items in the vicinity of the generator that may inhibit operation or represent cause of potential injury.
- Enquire if any operational difficulties are being experienced by the customer, correct or demonstrate as necessary.
- Starting and test run of generators.
- Fuel system, which includes gauges and fuel tanks etc.
- Inspection of exhaust system for leaks and audio pollution.
- Governing operations and adjustment as needed.
- Checking the coolant level.
- Checking the fuel supply and level of fuel.
- Checking the level and condition of the lubricating oil.
- Checking for water in pre-filters
- Cleaning the air cleaner if the engine is operating in very dusty conditions.
- Cleaning the air cleaner if the engine is operating in moderately dust conditions.
- Checking the serviceability of the battery.
- Checking battery chargers' functionality.
- Checking the condition and tension of the radiator or axial fan drive belt.
- Checking the alternator stator motor.
- Replacing the fuel filter element if the fuel is not perfectly clean.
- Replacing the air clean element every 600 hours.
- Checking the air induction system for leaks, damage and restrictions.
- Checking all external nuts, bolts and unions for tightness.

- Ensuring that all guards are firmly attached and not damaged.
- Checking the engine and speed controls for free movement.
- Cleaning the radiator fins and the axial fan drive belt irrespective of condition.
- Checking the lubricating oil pressure.
- Submitting 'Post Maintenance Visit' report on a template approved by.
- Checking that 'Hours meter', 'Volt Meter' and 'Amp Meter' are functional. Work scope also includes replacement of consumables like 'filter', 'lube oil', 'electrolyte or coolant', 'battery' and faulty ATS/AMF parts as required and mentioned in preventive maintenance work.

4.7.3.2 Engine, Fuel and Cooling System

- Check radiator coolant level.
- Check fan belt tension.
- Check Cooling Fins of radiator.
- Check Hose Pipes of Radiators.
- Check the fuel pump is working properly.
- Check the fuel filter pipes are cleaned and have no obstruction inside.
- Check the radiator condition should not be choked or blocked.
- Check the fuel pipe lines are cleaned and have no obstruction inside.
- Check the fuel gauge is functioning properly.
- Check the fuel & oil is not spilled on Genset & floor surroundings.

4.7.3.3 Electric System

- Check battery electrolyte level.
- Check the battery voltage level.
- Check tightness of all cable clips and wiring.
- Check function of all instruments and indication lights on ATS and Generator panel.
- Check the magnetic contactor functioning properly.
- Check all protection components such as timers, relays, breakers, switches are working properly.
- Ensure that all safety systems will function properly in the event of a fault.

5.0 CORRECTIVE MAINTENANCE SCOPE OF WORK FOR GENERATORS

Trouble-shooting and resolving all problems related to DG sets. Under this service, for properly and timely maintenance and prompt rectifications of problems.

1. Contractor shall ensure its teams' availability; 24hrs 7days a week and they should be reachable through telephone/designated line

Following procedure shall be adhered to and shall be responsible to attend to and rectify DG faults strictly in accordance with 'Severity Levels' explained below:

- i) on-call teams to reach the site as per following response time:
Within City – one-two Hours
- ii) on call team reaches the sites, attends the alarm keeping Client/Operating Agency/body On-call Engineer abreast about the progress.
- iii. After fixing the issue, on-call team informs Client/Operating Agency/body on call engineer before leaving the site.
- iv. In case replacement of faulty part is required, on-call team shall seek assistance from their head office/regional offices and make their best efforts to restore DG's operation in minimum possible time.

The bidder shall use genuine spare parts from the diesel Engine manufacturer and Alternators, stock inventory shall always be available in adequate quantity of all spare parts including consumables. Only renowned brands of Diesel Engine lube Oils like Shell, Total & Caltex of API-CE standards shall be used.

6.0 MAINTENANCE SCHEDULE

- | | | | |
|---|-----------------------------|---|------------------------------|
| A | Daily or every 8 hours | D | Every 1000 hours or 12 month |
| B | Every 150 hours | E | Every 2000hours |
| C | Every 250 hours or 6 months | | |

A	B	C	D	E	Operation
•					Check the amount of coolant
•					Check the condition and the tension of the drive belt
•					Check for water in the pre-filter
		•			Renew the elements of the fuel filter(s)
				•	Ensure that the atomizers are checked
•					Check the amount of lubricating oil in the sump
•					Check the lubricating oil pressure at the gauge
		•			Renew the engine lubricating oil
		•			Renew the canisters of the lubricating oil filter
•			•		Clean or renew the air filter element
				•	Check The Air After cooler (If Available)
				•	Check water pump
				•	Ensure that the turbocharger impeller casing and (if Available)
					turbocharger compressor casing are cleaned
				•	Ensure the compressor is checked (if one fitted)
			•		Ensure that the valve tip clearances of the engine are checked and, if necessary adjusted
				•	Ensure that the alternator and the starter motor are checked

SUPPLY, INSTALLATION AND TESTING

SCHEDULE OF TECHNICAL DATA TO BE FILLED IN FOR EVERY TYPE/RATING OF DG SETS AND SEALED/STAMPED BY THE MANUFACTURER- (MANDATORY)

Sr. No	Data Required	Data To Be Submitted (By Bidder)
1	ENGINE	
	Manufacturer's Name/ Country of Origin	
	Model	
	Maximum Engine Rating -(BHP)	
	Continuous Output Rating -(BHP)	
	Derating Factor:	
	(i) For Altitude of 1250 meters above MSL	
	(ii) For inlet Air Temperature of	
	(iii) Others if any	
	Engine Rating at Site-(BHP)	
	Period of maximum Engine Rating in Hours	
	Operating speed-RPM	
	Piston Speed (m/s)	
	Bore & Stroke-Inches	
	No. of cylinders	
	Arrangement of Cylinders (in line/v)	
	Engine Capacity-Cu.in./cc	
	Compression Ratio	
	Coupling Type	
	Mounting Arrangement	

Sr. No	Data Required	Data To Be Submitted (By Bidder)
	Cooling System	
	Ignition System	
	Overload Capability	
	Governor Type And Make	
	Efficiency at 0.85 pf % At 25% of rated load At 50% of rated load At 75% of rated load At 100% of rated load	— — — —
	Lube oil consumption (Liters/hr) At 0% of rated load At 25% of rated load At 50% of rated load At 75% of rated load At 100% of rated load	— — — — —
	Specific Fuel consumption (Liters/hr) At 0% of rated load At 25% of rated load At 50% of rated load At 75% of rated load At 100% of rated load	— — — — —
	Lubrication system nominal oil pressure (kg/cm ²)	
	Lubrication system minimum oil pressure (kg/cm ²)	
	Lubricating oil Sump capacity (ltr.)	
	Radiator capacity (ltr.)	
	Compusion air intake at 50 Hz (cm ³)	
	Engine heat radiation (K cal/min.)	
	Exhaust gas temperature at manifold, deg C.	
	Exhaust gas rate (ltr/sec.)	
	Starting system voltage (v)	
	Specific Feature if any	

Sr. No	Data Required	Data To Be Submitted (By Bidder)
2	GENERATOR	
	Manufacturer's Name/ Country of Origin	
	Model	
	Design Rating -(KVA)	
	Continuous Output Rating -(KVA)	
	Net electrical Output at site -(KVA)	
	Rated Voltage-volts	
	Power Factor	
	Speed-(RPM)	
	Frequency-Hz	
	Type designation	
	Time delay	
	(i) Manufacturer	
	(ii) Type designation	
	Timing	
	(i) Manufacturer	
	(ii) Type designation	
	Tripping	
	Insulation class	
	Stator Rotor Exciter	
	Overload Capability %	
	Harmonic Content %	
	Temperature Rise °C	
	Voltage Regulation	

Sr. No	Data Required	Data To Be Submitted (By Bidder)
	Type	
	Regulator	
	Regulation %	
	Voltage Dip %	
	Response Time (Sec)	
	Frequency Regulation -%	
	Deviation Factor %	
	Efficiency at 0.85 pf % At 25% of rated load At 50% of rated load At 75% of rated load At 100% of rated load	
	Exciter	
	Type	
	Rated Voltage-Volts	
	Full load current -Amps.	
	Radio Frequency Interference	
	Telephone interference factor	
	Charge Capacity	
	Batteries Type Rating-AH	
	Noise output level of Set (dB) At 0 % of rated load At 25% of rated load At 50% of rated load At 75% of rated load At 100% of rated load	

Sr. No	Data Required	Data To Be Submitted (By Bidder)
	De-rating Factor	
	For Altitude of given height in meters above MSL of the site of installation	
	For ambient temperature of	
	others ,if any	
	Special features, if any	
3	ACCESSORIES	
	(Contractor to state if any of the following accessories will be supplied - give details) Crankcase Heater Automatic water Makeup System Ducting for radiator Exhaust System Silencer Fuel Day Tank Fuel Piping System Fuel pump	
	Meters/Gauges to indicate: Engine speed in rpm Lube oil Pressure in Bars Lube oil temperature in °C Engine running hours in hrs. Battery Charging current in Amps.	
	Alarm/Indicating lamps for Engine Overspeed Low lube oil pressure High engine water temperature Over voltage Under voltage Short-circuit/tripping of main circuit breaker low fuel level	

Sr. No	Data Required	Data To Be Submitted (By Bidder)
	High fuel level Winding temperature high Over cranking Low oil level High oil level Charging alternator failure	
	Safety devices for instantaneous shut down due to Engine over speed Low lube oil pressure High water temperature shut down	
	Safety devices for adjustable delayed shut down, through shut down timer, due to: Over voltage Short circuit/tripping of main circuit breaker Low fuel oil in tank Winding temperature high	

Note: To be filled for each rating of DG Set from the Manufacturer.