



RUMBIYE WATER SUPPLY AND SANITATION PROJECT – PHASE 2

TENDER DOCUMENT

TENDER NAME: TENDER FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF A SOLAR POWERED WATER PUMPING SYSTEM TO EXISTING BOREHOLE

TENDER NO: RC/RCWSP/LOT-02/2022

CATEGORY: OPEN

Rotary Club of Busia
P.O Box 418- 50400
Busia

E-MAIL: rotaryclubofbusia@gmail.com/rumbiye@googlegroups.com

NOVEMBER 2022

TENDER CLOSING DATE & TIME: 3RD FEBRUARY 2023 AT 1200HRS (EAST AFRICAN TIME)

*TENDER FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF A SOLAR POWERED
WATER PUMPING SYSTEM TO EXISTING BOREHOLE*

1 SECTION I: INVITATION FOR TENDERS

TENDER CLOSING DATE: 3RD FEBRUARY 2023
TENDER REFERENCE NO.: RC/RCWSP/LOT-02/2022
TENDER NAME: SUPPLY, INSTALLATION, TESTING AND COMMISSIONING
OF A SOLAR POWERED WATER PUMPING SYSTEM TO
EXISTING BOREHOLE

The **Rotary International in conjunction with the host and international sponsor** has allocated funds to the **Rotary Club of Busia** for the project; Rumbiye **Community Water Supply Project**, **Tender No. RC/RCWSP/LOT-02/2022.**

- 1.1 The Rotary Club of Busia now invites sealed bids from eligible bidders for the construction of **SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF A SOLAR POWERED WATER PUMPING SYSTEM TO EXISTING BOREHOLE.**
- 1.2 The following are mandatory requirements that must be submitted together with the Bid document:
- Firms Copy of Relevant Registration with National Construction Authority category NCA 7 and above as a water works and Electrical/Mechanical contractor.
 - Certified copy of Certificate of Incorporation, Valid Business Permit, CR 12 and a Valid Tax Compliance Certificate.
 - Firm's Audited Accounts for the last Two (2) years,
 - References on previous experiences for similar works, Availability of Qualified Personnel and equipment.
 - Evidence of adequate plant and equipment and qualified personnel to undertake the works
 - Submission of valid EPRA Solar License (Company's Valid EPRA solar license C1 or V1)

Further information will be in the Bidding Document.

- 1.3 A pre-bid meeting and Site Visit Shall be held on **20TH JANUARY, 2023 at Rumbiye Primary School, Rumbiye sub-Location, Funyula Constituency, Busia County as from 1000Hrs.**
- 1.4 Interested eligible bidders may obtain further information from **Rotary Club of Busia, President**, rotaryclubofbusia@gmail.com / rumbiye@googlegroups.com during office hours from 0800 hours to 1700 Hours local time from Monday to Friday, except during lunch hour (1300 hours to 1400 hours), during weekends and public holidays at the address given below.
- 1.5 A complete set of bidding documents in English may be collected by interested eligible bidders upon request or can be downloaded from <https://ewb-kenya.org/tenders/> Bidders who download the bidding document from the website **MUST** forward their particulars immediately to rotaryclubofbusia@gmail.com / rumbiye@googlegroups.com for records and any further clarifications and addenda. Further information may be obtained from the address below:
- 1.6 All bids must be accompanied by a bid security of **2% of the bid price** in the form of an unconditional Bank Guarantee or from an insurance company registered by IRA and approved by PPRA.

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- 1.7 Eligible tenderers must provide the following **mandatory requirements** (preliminary evaluation). Non-submission of any of the documents will lead to disqualification from the tender process.
- a. Copy of certificate of Incorporation/Registration
 - b. Copy of **Valid** Tax compliance certificate.
 - c. Copy of CR 12
 - d. Copy of Certificate of Registration NCA 7 and above *in both Electrical and Mechanical Engineering Services*
 - e. Tender security of **2% of the bid price** in form of a bank guarantee from a bank registered in Kenya and recognized by the Central Bank of Kenya or a guarantee from an insurance company recognized by Public Procurement Oversight Authority.
 - f. Duly filled, signed and stamped Confidential Business Questionnaire (Section VIII).
 - g. Duly filled, signed and stamped Bidder's Declaration and Integrity Pact (Section VIII).
 - h. Properly bound, paginated and serialized document
- 1.8 Bids must be delivered to the address below on or before **12.00 p.m. East African Time on 3rd February, 2023**. Late bids will be rejected. Bids will be publicly opened in the presence of the bidders' designated representatives and anyone who choose to attend at the address below on **3rd February, 2023, at 12.00 noon** East African Time.

Addressed to:
The President
Rotary Club of Busia
P.O Box P.O Box 418- 50400, BUSIA
E-MAIL - rotaryclubofbusia@gmail.com / rumbiye@googlegroups.com

Submitted and registered at Rumbiye Primary School, Rumbiye sub-Location, Funyula Constituency, Busia County

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2 SECTION II – TENDERING PROCEDURES

2.1 SECTION II: INSTRUCTION TO TENDERERS

Note: The tenderer must comply with the following conditions and instructions and failure to do so is liable to result in rejection of the tender.

2.1.1 Definitions

GENERAL

- (a) **“Tenderer”** means any person or persons partnership firm or company submitting a sum or sums in the Bills of Quantities in accordance with the Instructions to Tenderers, Conditions of Contract Parts I and II, Specifications, Drawings and Bills of Quantities for the work contemplated, acting directly or through a legally appointed representative.
- (b) **“Approved tenderer”** means the tenderer who is approved by the Employer.
- (c) Any noun or adjective derived from the word **“tender”** shall be read and construed to mean the corresponding form of the noun or adjective **“bid”**. Any conjugation of the verb **“tender”** shall be read and construed to mean the corresponding form of the verb **“bid”**.
- (d) **“Employer”** means **Rotary Club of Busia**
- (e) **“Project Manager”** means **Engineers Without Borders Kenya**.

2.1.2 Eligibility and Qualification Requirements

- 2.1 This invitation to tender is open to all tenderers who are eligible as stated in the appendix.
- 2.2 The procuring entity's employees, committee members, board members and their relative (spouse and children) are not eligible to participate in the tender.
- 2.3 To be qualified for award of Contract, the tenderer shall provide evidence satisfactory to the Employer of their eligibility under Sub clause 2.1 above and of their capability and adequacy of resources to effectively carry out the subject Contract. To this end, Where no pre-qualification of potential tenderers has been done, **all tenderers shall include the following information and documents with their tenders**, unless otherwise stated:
 - (a) Details of experience and past performance of the tenderer on the works of a similar nature within the past five years and details of current work on hand and other contractual commitments.
 - (b) The qualifications and experience of key personnel proposed for administration and execution of the contract, both on and off site.
 - (c) Major items of construction plant and equipment proposed for use in carrying out the Contract. Only reliable plant in good working order and suitable for the work required of it shall be shown on this schedule. The tenderer will also indicate on this schedule when each item will be available on the Works. Included also should be a schedule of plant, equipment and material to be imported for the purpose of the Contract, giving details of make, type, origin and CIF value as appropriate.
 - (d) Details of proposed subcontractors to whom it is proposed to sublet any portion of the Contract and for whom authority will be requested for such subletting in accordance with clause 4 of the Conditions of Contract. A draft Program of Works in the form of a bar chart and Schedule of Payment which shall form part of the Contract if the tender is

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accepted. Any change in the Program or Schedule shall be subjected to the approval of the Engineer.

- (e) Details of any current litigation or arbitration proceedings in which the Tenderer is involved as one of the parties.

2.4 Joint Ventures

Tenders submitted by a joint venture of two or more firms as partners shall comply with the following requirements:

- (a) The tender, and in case of a successful tender, the Form of Agreement, shall be signed so as to be legally binding on all partners.
- (b) One of the 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 partners.
- (c) The partner in charge shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture and the entire execution of the Contract including payment shall be done exclusively with the partner in charge.
- (d) All partners of the joint venture shall be liable jointly and severally for the execution of the Contract in accordance with the Contract terms, and a relevant statement to this effect shall be included in the authorization mentioned under (b) above as well as in the Form of Tender and the Form of Agreement (in case of a successful tender).
- (e) A copy of the agreement entered into by the joint venture partners shall be submitted with the tender.

2.5 To qualify for contract awards, the tenderer shall have the following:

- a) Necessary qualifications, capability experience, services, equipment and facilities to provide what is being procured.
- b) Legal capacity to enter into a contract for procurement
- c) Shall not be insolvent, in receivership, bankrupt or in the process of being wound up and is not the subject of legal proceedings relating to the foregoing.
- d) Shall not be debarred from participating in public procurement.

2.1.3 Cost of Tendering

3.1 The tenderer shall bear all costs associated with the preparation and submission of his tender and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the tendering process.

2.1.4 Site Visit

- 4.1 There will be a **MANDATORY** Pre-Tender site meeting that will take place on 20th January 2023 at Rumbiye Primary School, Rumbiye sub-Location, Funyula Constituency, Busia County as from 1000Hrs.
- 4.2 The tenderer is advised to then examine the Site and its surroundings and obtain for himself on his own responsibility, all information that may be necessary for preparing the tender and entering into a contract. The costs of visiting the Site shall be the tenderer's own responsibility.
- 4.3 The tenderer and any of his personnel or agents will be granted permission by the Employer to enter upon premises and lands for the purpose of such inspection, but only upon the express condition that the tenderer, his personnel or agents, will release and indemnify the

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Employer from and against all liability in respect of, and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused, which but for the exercise of such permission, would not have arisen.

2.1.5 Tender Documents

- 5.1 The Tender documents comprise the documents listed here below and should be read together with any Addenda issued in accordance with Clause 7 of these instructions to tenderers.
- (a) Form of Invitation for Tenders
 - (b) Instructions to Tenderers
 - (c) Form of Tender
 - (d) Appendix to Form of Tender
 - (e) Form of Tender Surety
 - (f) Statement of Foreign Currency Requirements
 - (g) Form of Performance Security
 - (h) Form of Agreement
 - (i) Form of Advance payment Bank Guarantee
 - (j) Schedules of Supplementary Information
 - (k) General Conditions of Contract – Part I
 - (l) Conditions of Particular Application – Part II
 - (m) Specifications
 - (n) Bills of Quantities
 - (o) Declaration Form
- 5.2 The tenderer is expected to examine carefully all instructions, conditions, forms, terms, specifications and drawings in the tender documents. Failure to comply with the requirements for tender submission will be at the tenderer's own risk. Pursuant to clause 22 of Instructions to Tenderers, tenders which are not substantially responsive to the requirements of the tender documents will be rejected.
- 5.3 All recipients of the documents for the proposed Contract for the purpose of submitting a tender (whether they submit a tender or not) shall treat the details of the documents as "private and confidential"

2.1.6 Clarification of Tenders

- 6.1 A tenderer making inquiries relating to the tender documents may notify the Employer in writing or by telex, cable or facsimile at the Employer's mailing address indicated in the Invitation to Tender. The Employer will respond in writing to any request for clarification, which he receives earlier than 7 days prior to the deadline for the submission of tenders. Written copies of the Employer's response (including the query but without identifying the source of the inquiry) will be sent to all prospective tenderers who have purchased the tender documents.
- 6.2 Clarification of tenders shall be requested by the tenderer to be received by the procuring entity not later than 7 days prior to the deadline for submission of tenders.
- 6.3 The procuring entity shall reply to any clarifications sought by the tenderer within 3 days of receiving the request to enable the tenderer to make timely submission of its tender.

2.1.7 Amendment of Tender Documents

- 7.1 At any time prior to the deadline for submission of tenders the Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective tenderer, modify the tender documents by issuing Addenda.
- 7.2 Any Addendum will be notified in writing or by cable, telex or facsimile to all prospective tenderers who have purchased the tender documents and will be binding upon them.
- 7.3 In order to allow prospective tenderers reasonable time in which to take the Addendum into account in preparing their tenders, the Employer may, at his discretion, extend the deadline for the submission of tenders.

2.1.8 Language of Tender

- 8.1 The tender and all correspondence and documents relating to the tender exchanged between the tenderer and the Employer shall be written in the English language. Supporting documents and printed literature furnished by the tenderer with the tender may be in another language provided they are accompanied by an appropriate translation of pertinent passages in the above stated language. For the purpose of interpretation of the tender, the English language shall prevail.

2.1.9 Documents Comprising the Tender

- 9.1 The tender to be prepared by the tenderer shall comprise:
 - a) The form of tender and appendix thereto.
 - b) A tender security.
 - c) The priced Bill of Quantity and Schedule.
 - d) The information on eligibility and qualification.
 - e) Detailed Compliance to The Technical Requirements
 - f) Catalogues and Manufacturers Brochures
 - g) Manufacturers Authorization for all items
 - h) Manufacturer's Warranty for all items
 - i) Financial Capability
 - j) List of Previous Customers
 - k) Any other materials required to be completed and submitted in accordance with the instructions to tenderers.
- 9.2 The Forms, Bills of Quantities and Schedules provided in the tender documents shall be used without exception (subject to extensions of the schedules in the same format and to the provisions of clause 13.2 regarding the alternative forms of Tender Surety).

2.1.10 Tender Prices

- 10.1 All the insertions made by the tenderer shall be made in INK and the tenderer shall clearly form the figures. The relevant space in the Form of Tender and Bills of Quantities shall be completed accordingly without interlineations or erasures except those necessary to correct errors made by the tenderer in which case the erasures and interlineations shall be initialed by the person or persons signing the tender.
- 10.2 A price or rate shall be inserted by the tenderer for every item in the Bills of Quantities whether the quantities are stated or not items against which no rate or price is entered

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by the tenderer will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bills of Quantities.

- 10.3 The prices and unit rates in the Bills of Quantities are to be the full [all-inclusive] value of the work described under the items, including all costs and expenses which may be necessary and all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based. All duties and taxes and other levies payable by the Contractor under the Contract or for any other cause prior to the deadline for the submission of tenders, shall be included in the rates and prices and the total tender prices submitted by the Tenderer.
- 10.4 Each price or unit rate inserted in the Bills of Quantities should be a realistic estimate for completing the activity or activities described under that particular item and the tenderer is advised against inserting a price or rate against any item contrary to this instruction.
- 10.5 Every rate entered in the Bills of Quantities, whether or not such rate be associated with a quantity, shall form part of the Contract. The Employer shall have the right to call for any item of work contained in the Bills of Quantities, and such items of work to be paid for at the rate entered by the tenderer and it is the intention of the Employer to take full advantage of unbalanced low rates.
- 10.6 Unless otherwise specified the tenderer must enter the amounts representing 10% of the sub- total of the summary of the Bills of Quantities for Contingencies and Variation of Prices [V.O.P.] payments in the summary sheet and add them to the sub-total to arrive at the tender amount.
- 10.7 The tenderer shall furnish with his tender written confirmation from his suppliers or manufacturers of unit rates for the supply of items listed in the Conditions of Contract clause 47 where appropriate.
- 10.8 The rates and prices quoted by the tenderer are subject to adjustment during the performance of the Contract only in accordance with the provisions of the Conditions of Contract. The tenderer shall complete the schedule of basic rates and shall submit with his tender such other supporting information as required under clause 47 of the Conditions of Contract Part II.

2.1.11 Currencies of Tender and Payment

- 11.1 Tenders shall be priced in Kenya Shillings or any other convertible currency.
- 11.2 Tenderers are required to indicate in the Statement of Foreign Currency Requirements, which forms part of the tender, the foreign currency required by them. Such currency should generally be the currency of the country of the tenderer's main office. However, if a substantial portion of the tenderer's expenditure under the Contract is expected to be in countries other than his country of origin, then he may state a corresponding portion of the contract price in the currency of those other countries. However, the foreign currency element is to be limited to two (2) different currencies and a maximum of 30% (thirty percent) of the Contract Price.
- 11.3 The rate or rates of exchange used for pricing the tender shall be selling rate or rates of the Central Bank of Kenya ruling on the date closing of tenders.

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- 11.4 Tenderers must enclose with their tenders, a brief justification of the foreign currency requirements stated in their tenders.

2.1.12 Tender Validity

- 12.1 The tender shall remain valid and open for acceptance for a period of One Hundred and Twenty (120) days from the specified date of tender opening or from the extended date of tender opening (in accordance with clause 7.4 here above) whichever is the later.
- 12.2 In exceptional circumstances prior to expiry of the original tender validity period, the Employer may request the tenderer for a specified extension of the period of validity. The request and the responses thereto shall be made in writing or by cable, telex or facsimile. A tenderer may refuse the request without forfeiting his Tender Surety. A tenderer agreeing to the request will not be required nor permitted to modify his tender, but will be required to extend the validity of his Tender Surety correspondingly.

2.1.13 Tender Security

- 13.1 The tenderer shall furnish, as part of its Tender, a tender security for the amount specified in the Appendix to Instructions to Tenderers.
- 13.2 The tender security shall be either one or a combination of the following: -
- a. An original Bank Guarantee that is strictly in the form and content as prescribed in the Tender Security Form (Bank Guarantee) in the Tender Document.
 - b. For Local bidders, Standby Letters of Credit (LC). All costs, expenses and charges levied by all banks party to the LC shall be prepaid by the Tenderer. The LC must contain all the mandatory conditions of payment to Rotary Club of Busia as prescribed in the Tender Security (Letters of Credit) provided in the Tender Document.
- 13.3 The tender security shall be 2 percent of the tender price.
- 13.4 The tender security shall be valid for at least thirty (30) days beyond the tender validity period.
- 13.5 The format of the Surety shall be in accordance with the sample form of Tender Surety included in these tender documents; other formats may be permitted subject to the prior approval of the Employer. The Tender Surety shall be valid for thirty (30) days beyond the tender validity period.
- 13.6 Any tender not accompanied by an acceptable Tender Surety will be rejected by the Employer as non-responsive.
- 13.7 The Tender Sureties of unsuccessful tenderers will be returned as promptly as possible as but not later than fourteen (14) days after concluding the Contract execution and after a Performance Security has been furnished by the successful tenderer. The Tender Surety of the successful tenderer will be returned upon the tenderer executing the Contract and furnishing the required Performance Security.
- 13.8 The Tender Surety may be forfeited:
- a. if a tenderer withdraws his tender during the period of tender validity: or
 - b. in the case of a successful tenderer, if he fails

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- c. to sign the Agreement, or
- d. to furnish the necessary Performance Security
- e. if a tenderer does not accept the correction of his tender price pursuant to clause 23.

2.1.14 No Alternative Offers

- 14.1** The tenderer shall submit an offer which complies fully with the requirements of the tender documents unless otherwise provided for in the appendix.
- 14.2** Only one tender may be submitted by each tenderer either by himself or as partner in a joint venture.
- 14.3** The tenderer shall not attach any conditions of his own to his tender. The tender price must be based on the tender documents. The tenderer is not required to present alternative construction options and he shall use without exception, the Bills of Quantities as provided, with the amendments as notified in tender notices, if any, for the calculation of his tender price.
- 14.4** Any tenderer who fails to comply with this clause will be disqualified.

2.1.15 Pre-Tender Meeting

- 15.1** If a pre- tender meeting is convened the tenderer's designated representative is invited to attend a pre-tender meeting, which if convened, will take place at the venue and time stated in the Invitation to Tender. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
- 15.2** The tenderer is requested as far as possible to submit any questions in writing or by cable, to reach the Employer not later than seven days before the meeting. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted in accordance with the following:
 - (a) Minutes of the meeting, including the text of the questions raised and the responses given together with any responses prepared after the meeting will be transmitted without delay to all purchasers of the tender documents. Any modification of the tender documents listed in Clause 9 which may become necessary as a result of the pre-tender meeting shall be made by the Employer exclusively through the issue of a tender notice pursuant to Clause 7 and not through the minutes of the pre-tender meeting.
 - (b) Non-attendance at the pre-tender site meeting will lead to disqualification of the tenderers bid.

2.1.16 Format and Signing of Bid

- 16.1** The Bidder shall prepare one original of the documents comprising the Bid as described in ITT
- 16.2** Bidders shall mark as "CONFIDENTIAL" information in their Bids which is confidential to their business. This may include proprietary information, trade secrets, or commercial or financially sensitive information.
- 16.3** The bid documents shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation notarized by a Commissioner of Oath which shall be attached to the Bid. The name and position held by each person signing the authorization must be typed or printed below the signature.

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All pages of the Bid where entries or amendments have been made shall be signed or initialed by the person signing the Bid.

16.4 In case the Bidder is a JV, the Bid shall be signed by an authorized representative of the JV on behalf of the JV, and so as to be legally binding on all the members as evidenced by a power of attorney signed by their legally authorized representatives.

16.5 Any interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Bid.

2.1.17 Preparation of Bids

17.1 The tenderer shall prepare two copies of the tender, clearly marking each "ORIGINAL TENDER" and "COPY OF TENDER," as appropriate. In the event of any discrepancy between them, the original shall govern.

17.2 The original and all copies of the tender shall be typed or written in indelible ink and shall be signed by the tenderer or a person or persons duly authorized to bind the tenderer to the contract. All pages of the tender, except for unamended printed literature, shall be initialed by the person or persons signing the tender.

17.3 The tender shall have no interlineations, erasures, or overwriting except as necessary to correct errors made by the tenderer, in which case such corrections shall be initialed by the person or persons signing the tender.

17.4 The original and all copies of the tender shall be typed or written in indelible ink and shall be signed by the tenderer or a person(s) duly authorized to bind the tenderer to the contract. All pages of the tender, except for unamended printed literature, shall be initialed by the person(s) signing the tender.

2.1.18 Sealing and Marking of Tenders

The tenderer shall seal the original and each copy of the tender in separate envelopes, duly marking the envelopes as "ORIGINAL" and "COPY." The envelopes shall then be sealed in an outer envelope.

The inner and outer envelopes shall be addressed to the Procuring entity at the address given in the invitation to tender; bear, tender number and name in the invitation to tender and the words: "DO NOT OPEN BEFORE 17th February 2021 at 1000hrs (East Africa Time)".

The inner envelopes shall also indicate the name and address of the tenderer to enable the tender to be returned unopened in case it is declared "late".

If the outer envelope is not sealed and marked as required by clause 2.15.2, the Procuring entity will assume no responsibility for the tender's misplacement or premature opening.

2.1.19 Deadline for Submission of Tenders

Tenders must be received by the Procuring entity at the address specified in the Invitation to Tender no later than, **3rd February, 2023 at 1200hrs (East Africa Time).**

The procuring entity may, at its discretion, extend this deadline for the submission of tenders by amending the tender documents in accordance with clause 2.5, in which case all rights and obligations of the procuring entity and candidates previously subject to the deadline will thereafter be subject to the deadline as extended.

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Bulky tenders which will not fit in the tender box shall be received by the procuring entity as provided for in the appendix.

2.1.20 Modification and withdrawal of tenders

- 20.1 The tenderer may modify or withdraw its tender after the tender's submission, provided that written notice of the modification, including substitution or withdrawal of the tender's is received by the procuring entity prior to the deadline prescribed for the submission of tenders.
- 20.2 The Tenderer's modification or withdrawal notice shall be prepared, sealed, marked, and dispatched in accordance with the provisions of clause 2.15. A withdrawal notice may also be sent by cable, but followed by a signed confirmation copy, postmarked not later than the deadline for submission of tenders.
- 20.3 No tender may be modified after the deadline for submission of tenders.
- 20.4 No tender may be withdrawn in the interval between the deadline for submission of tenders and the expiration of the period of tender validity specified by the tenderer on the Tender Form. Withdrawal of a tender during this interval may result in the Tenderer's forfeiture of its tender security, pursuant to clause 2.12.7.
- 20.5 The procuring entity may at any time terminate procurement proceedings before contract award and shall not be liable to any person for the termination.
- 20.6 The procuring entity shall give prompt notice of the termination to the tenderers and on request give its reasons for termination within 14 days of receiving the request from any tenderer.

2.1.21 Opening of Tenders

- 21.1 The Procuring entity will open all tenders in the presence of tenderers' representatives who choose to attend on **3rd February, 2023 at 1200hrs (East Africa Time)** and in the location specified in the invitation to tender. The tenderers' representatives who are present shall sign a register evidencing their attendance.
- 21.2 The tenderers' names, tender modifications or withdrawals, tender prices, discounts, and the presence or absence of requisite tender security and such other details as the Procuring Entity, at its discretion, may consider appropriate, will be announced at the opening.
- 21.3 The procuring entity will prepare minutes of the tender opening which will be submitted to the tenderers that signed the tender opening register and will have made the request.

2.1.22 Process to be Confidential

- 22.1 After the public opening of tenders, information relating to the examination, clarification, evaluation and comparisons of tenders and recommendations concerning the award of Contract shall not be disclosed to tenderers or other persons not officially concerned with such process until the award of Contract is announced.
- 22.2 Any effort by a tenderer to influence the Employer in the process of examination, evaluation and comparison of tenders and decisions concerning award of Contract may result in the rejection of the tenderer's tender.

2.1.23 Clarification Tenders

- 21.1. To assist in the examination, evaluation and comparison of tenders, the Employer may ask tenderers individually for clarification of their tenders, including breakdown of unit prices. The request for clarification and the response shall be in writing or by cable, facsimile or telex, but no change in the price or substance of the tender shall be sought, offered or permitted except as required to confirm the correction of arithmetical errors discovered by the employer during the evaluation of the tenders in accordance with clause 24.
- 21.2. No Tenderer shall contact the Employer on any matter relating to his tender from the time of the tender opening to the time the Contract is awarded. If the tenderer wishes to bring additional information to the notice of the Employer, he shall do so in writing.

2.1.24 Determination of Responsiveness

- 24.1** Prior to the detailed evaluation of tenders, the Employer will determine whether each tender is substantially responsive to the requirements of the tender documents.
- 24.2** For the purpose of this clause, a substantially responsive tender is one which conforms to all the terms, conditions and specifications of the tender documents without material deviation or reservation. A material deviation or reservation is one which affects in any substantial way the scope, quality, completion timing or administration of the Works to be undertaken by the tenderer under the Contract, or which limits in any substantial way, inconsistent with the tender documents, the Employer's rights or the tenderers obligations under the Contract and the rectification of which would affect unfairly the competitive position of other tenderers who have presented substantially responsive tenders.
- 24.3** Each price or unit rate inserted in the Bills of Quantities shall be a realistic estimate of the cost of completing the works described under the particular item including allowance for overheads, profits and the like. Should a tender be seriously unbalanced in relation to the Employer's estimate of the works to be performed under any item or groups of items, the tender shall be deemed not responsive.
- 24.4** A tender determined to be not substantially responsive will be rejected by the Employer and may not subsequently be made responsive by the tenderer by correction of the non-conforming deviation or reservation.

2.1.25 Correction of Errors

- 25.1** There shall be no correction of prices. Bid prices shall be the ones read out during opening and unless specified in the BDS shall be assumed to include all requisite taxes and levies

2.1.26 Conversion to Single Currency

- 26.1** For compensation of tenders, the tender price shall first be broken down into the respective amounts payable in various currencies by using the selling rate or rates of the Central Bank of Kenya ruling on the date on the date of tender closing.
- 26.2** The Employer will convert the amounts in various currencies in which the tender is payable (excluding provisional sums but including Day works where priced competitively) to Kenya Shillings at the selling rates stated in clause 24.1.

2.1.27 Evaluation and Comparison of Tenders

- 27.1** The Employer will evaluate and compare only tenders determined to be substantially responsive to the requirements of the tender documents in accordance with clause 23.

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- 27.2** In evaluating tenders, the Employer will determine for each tender the evaluated tender price by adjusting the tender price as follows:
- (a) Making any correction for errors pursuant to clause 24.
 - (b) Excluding Provisional Sums and provision, if any, for Contingencies in the Bills of Quantities, but including Day works where priced competitively.
- 27.3** The Employer reserves the right to accept any variation, deviation or alternative offer. Variations, deviations, alternative offers and other factors which are in excess of the requirements of the tender documents or otherwise result in the accrual of unsolicited benefits to the Employer, shall not be taken into account in tender evaluation.
- 27.4** Price adjustment provisions in the Conditions of Contract applied over the period of execution of the Contract shall not be taken into account in tender evaluation.
- 27.5** If the lowest evaluated tender is seriously unbalanced or front loaded in relation to the Employer's estimate of the items of work to be performed under the Contract, the Employer may require the tenderer to produce detailed price analyses for any or all items of the Bills of Quantities, to demonstrate the relationship between those prices, proposed construction methods and schedules. After evaluation of the price analyses, the Employer may require that the amount of the Performance Security set forth in clause 29 be increased at the expense of the successful tenderer to a level sufficient to protect the Employer against financial loss in the event of subsequent default of the successful tenderer under the Contract.
- 27.6** Firms incorporated in Kenya where indigenous Kenyans own 51% or more of the share capital shall be allowed a 15% preferential bias provided that they do not sub-contract work valued at more than 50% of the Contract Price excluding Provisional Sums to a non- indigenous sub-contractor.
- 27.7** The tender evaluation committee shall evaluate the tender within 30 days of the validity period from the date of opening the tender.
- 27.8** Persons not officially involved in the evaluation of tender shall not attempt in any way to influence the evaluation.

2.2 AWARD OF CONTRACT

2.2.1 Post – Qualification and Award

- 28.1** In the absence of pre-qualification, the employer will determine to its satisfaction whether the tenderer that is selected as having submitted the lowest evaluated responsive tender is qualified to perform the contract satisfactorily.
- 28.2** The determination will take into account the tenderer financial, technical and production activities. It will be based on examination of the documentary evidence of the tenderers qualifications submitted by the tenderer, as well as such other information as the employer deems necessary and appropriate.
- 28.3** An affirmative determination will be a pre-requisite for award of the contract to the tenderer. A negative determination will result in rejection of the tenderer's tender, in which the employer will proceed to the next lowest evaluated tender to make a similar determination of that Tenderer's capabilities to perform satisfactorily.
- 28.4** Subject to clause 26.2, the Employer will award the Contract to the tenderer whose tender is determined to be substantially responsive to the tender documents and who

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has offered the lowest evaluated tender price subject to possessing the capability and resources to effectively carry out the Contract Works.

2.2.2 Rejection of all tenders

- 29.1** The Employer reserves the right to accept or reject any tender, and to annul the tendering process and reject all tenders, at any time prior to award of Contract, without thereby incurring any liability to the affected tenderers or any obligation to inform the affected tenderers of the grounds for the Employer's action.
- 29.2** The Employer reserves the right at the time of contract award to increase or decrease the number of projects originally specified in the schedule of projects without any change in unit price or other terms and conditions.

2.2.3 Notification of Award and signing of contract

- 30.1** Prior to the expiration of the period of tender validity prescribed by the Employer, the Employer will notify the successful tenderer by cable, telefax or telex and confirmed in writing by registered letter that his tender has been accepted. This letter (hereinafter and in all Contract documents called "Letter of Acceptance") shall name the sum (hereinafter and in all Contract documents called "the Contract Price") which the Employer will pay to the Contractor in consideration of the execution and completion of the Works as prescribed by the Contract.
- 30.2** Upon the furnishing of a Performance Security by the successful tenderer, the unsuccessful tenderers will promptly be notified that their tenders have been unsuccessful.
- 30.3** At the same time the employer notifies the successful tenderer that his tender has been accepted, the employer shall notify the other tenderers that their tenders have been unsuccessful.
- 30.4** Within fourteen [14] days of receipt of the form of Contract Agreement from the Employer, the successful tenderer shall sign the form and return it to the Employer together with the required Performance Security.
- 30.5** The parties to the contract shall have it signed within 30 days from the date of notification of contract award unless there is an administrative review request.
- 30.6** A tenderer who gives false information in the tender document about is qualification or who refuses to enter into a contract after notification of contract award shall be considered for debarment from participating in future public procurement.

2.2.4 Performance Guarantee

- 31.1** Within twenty-eight [28] days of receipt of the notification of award from the Employer, the successful tenderer shall furnish the Employer with a Performance Security in an amount stated in the Appendix to Instructions to Tenderers.
- 31.2** The Performance Security to be provided by the successful tenderer shall be an unconditional Bank Guarantee issued at the tenderer's option by an established and a reputable Bank approved by the Employer and located in the Republic of Kenya and shall be divided into two elements namely, a performance security payable in foreign currencies

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and performance security payable in Kenya Shillings. The value of the two securities shall be in the same proportions of foreign and local currencies as requested in the form of foreign currency requirements.

- 31.3** Failure of the successful tenderer to lodge the required Performance Security shall constitute a breach of Contract and sufficient grounds for the annulment of the award and forfeiture of the Tender Security and any other remedy under the Contract the Employer may award the Contract to the next ranked tenderer.

2.2.5 Advance Payment

- 32.1** An advance payment, if approved by the Employer, shall be made under the Contract, if requested by the Contractor, in accordance with the Conditions of Contract. The Advance Payment Guarantee shall be denominated in the proportion and currencies named in the form of foreign currency requirements. For each currency, a separate guarantee shall be issued. The guarantee shall be issued by a bank located in the Republic of Kenya, or a foreign bank through a correspondent bank located in the Republic of Kenya, in either case subject to the approval of the Employer.

2.2.6 Corrupt and fraudulent practices

- 33.1** The procuring entity requires that tenderers observe the highest standard of ethics during the procurement process and execution of contract. A tenderer shall sign a declaration that he has not and will not be involved in corrupt or fraudulent practices.

2.3 APPENDIX TO INSTRUCTIONS TO TENDERERS

The following information regarding the particulars of the tender shall complement and or amend the provisions of the Instructions to Tenderers *hereinafter abbreviated as ITT*. Wherever there is a conflict between the provisions of the ITT and the Appendix, the provisions of the Appendix herein shall prevail over those of the ITT.

No.	ITT Reference Clause	Particulars of Appendix
1	Eligible Tenderers	<i>Contractors Registered in Kenya with NCA 7 and above in both Electrical and Mechanical Engineering Services</i>
2	Origin of Eligible goods	<i>Any country is eligible</i>
3	Time for Completion of Works	<i>3 months</i>
4	Attendance of site visit	<i>There will be a MANDATORY site visit on 20th January 2023 at 10:00am at St. Rumbiye Primary School, Funyula constituency, Busia county</i>
5	Documents Comprising the Tender – List of Previous Customers	<i>The Tenderer shall submit at least five (4) names with full contact as well as physical addresses of previous customers of similar works/services and letters from the Previous customers confirming completion of the contracts on schedule.</i>
6	Documentary evidence of financial capability	<i>Two years audited financial statements required must be those that are reported within Fifteen (15) calendar months of the date of the tender document</i>
7	Catalogues, Brochures, and Drawings	<i>All technical documents and specifications pertaining to the product MUST be provided</i>
8	Warranty	<i>Warranty of one (1) year or Manufacturer's guarantee</i>

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9	Tender Currency	For avoidance of doubt, the currency of the tender Shall be in Kenya Shillings or easily convertible currency at the tender opening exchange rates
10	Tender Security	2% of the bid value.
11	Preparation & Submission of Tenders	Tenderers to submit 1(one) original and two (2) copies of the tender. Completed tender documents are to be enclosed in plain sealed envelopes clearly marked: “TENDER FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF A SOLAR POWERED WATER PUMPING SYSTEM TO EXISTING BOREHOLE” and “Tender Ref. No. RC/RCWSP/LOT-02/2022” with the instructions “Do not Open on or Before 3rd February, 2023 at 1200hrs (East Africa Time). at 1200hrs (East Africa Time)”, should be addressed to: THE PRESIDENT The President Rotary Club of Busia P.O Box P.O Box 418- 50400, BUSIA E-MAIL - rotaryclubofbusia@gmail.com / rumbiye@googlegroups.com Rumbiye Primary School, Rumbiye sub-Location, Funyula Constituency, Busia County.
12	Opening of Tenders	<i>The tenders shall be opened at <u>Rumbiye Primary School, Rumbiye sub-Location, Funyula Constituency, Busia County</u> in the presence of the bidders</i>
13	Performance Security	<i>Performance bond shall be 10% of the Total Contract value.</i>

3 SECTION III: SUMMARY OF EVALUATION PROCESS

3.1 PRELIMINARY EVALUATION

The following are the **MANDATORY Requirements** that **SHALL** constitute the evaluation criteria at the Preliminary Evaluation Stage:

- 1) Confirmation of submission of Tender Security from a local Bank inform of either; inform of Bank guarantee or Bankers' cheque or Insurance Guarantee (Insurance issuing the guarantee must be part of the Public Procurement Regulatory Authority (PPRA) approved list, which validity shall be at least 150 days from the date of tender opening. Tender security value. Tender security value SHALL be at least 2% (percent) of the tender price.
- 2) The tenderer SHALL attach copies of: Certificate of Incorporation of Business, Copy of E-PIN Certificate with both VAT and Income Tax Obligations.
- 3) Valid Tax Compliance Certificate at the time of tender submission, CR 12 Certificate issued not more than 3 months from the date of Tender closing
- 4) Copy of Business Permit in the County of Operation
- 5) Power of Attorney Notarized by a Magistrate or Commissioner of Oath Indicating the Authorized signatory for the documents of the bidder.
- 6) The tenderer **SHALL** dully fill the Standard Forms (Letter of Application, Form of Tender, Tender Questionnaire, Declaration Form and Confidential Business Questionnaire) in the format provided. Confirmation of tender validity period. Tenders **SHALL** be valid for at least 120 days from the date of tender opening.
- 7) The tenderer **SHALL** submit catalogues and brochures containing technical data as provided in the technical specifications for all main equipment - Solar module, Batteries, Inverter/Charger, Energy Meter, LED Lights. Only one catalogue/brochure to be submitted per equipment.
- 8) Submission of Detailed Mobilization Plan & Detailed Construction Schedule. This should be clear and demonstrate/indicate for each activity for a period not exceeding 10 weeks.
- 9) Verification of submission of Professional Qualification and experience for key staff, which key staff shall be the Project Supervisor and two (2) Technicians. At least two staff member with EPRA solar license, one of which must be T3.
- 10) The tenderer **SHALL** provide latest Audited financial reports for the last 15 months.
- 11) The tenderer **SHALL** provide details of experience and past performance on works of a similar nature within the past five years and details of current work on hand and other contractual commitments. The tenderer to attach at least 3 completion certificates from the owner of the works undertaken. The Applicants should have at least 2 years past experience in relevant works. T3 & T2 registration for respective technicians.
- 12) Confirmation of business Premise, workshops and service center with relevant tools and equipment whether owned or leased with evidence of valid lease agreements.
- 13) Submission of valid EPRA Solar License (Company's Valid EPRA solar license C1 or V1)
- 14) Submission of valid NCA 7 and above – electrical or Mechanical services with solar registration.

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- 15) Manufacturer's ISO9001:2015 certification or KEBS certification for local manufacturers for quality management for the key equipment i.e, Solar module, Batteries, Inverter/Charger, Energy Meter, LED lights should be valid.
- 16) Manufacturers ISO14001:2015 or NEMA / energy policy certification on Environmental Management Policy for key equipment - Solar module, Batteries, Inverter/Charger, Energy Meter, LED lights should be valid
- 17) Submission of evidence of an established up to date safety program, policies and work practices. Bidder to provide a written occupational health and safety policy.

NB: Tenders which do not satisfy any of the requirements set out above shall be rejected as per public procurement and disposal Act, 2015 and will not proceed to technical evaluation stage.

3.2 TECHNICAL EVALUATION

TECHNICAL EVALUATION					
No	Parameter			Maximum Score	
1	Relevant Experience Experience as prime contractor in the construction of at least three projects of similar nature and complexity equivalent to the Works in the last three years (10 Marks for each project)			30	
2	Equipment owned, co-owned or leased (Max.20Marks) (i) A lorry of capacity 7-10 tons mounted with crane and winch (ii) A Pickup (iii) Concrete mixer and poker vibrator (iv) Welding machine (maximum 20 marks)		Provide Proof of: ownership (20 marks) or Co- owned (20Marks) Or leased (20 marks)	20	
3	Key Personnel				
	Project supervisor (Maximum Marks) 10	Electrical or Mechanical Engineering or Renewable Energy and Registered with EBK as a graduate engineer Relevant Experience (10 years)	Degree	6	
			Diploma	3	
			5 – 10 years	4	
			1 – 4 years	3	
	2Nr. Electromechanical technicians (Mark 10)	Qualification: Diploma in relevant Engineering course (Minimum 5 years experience) Valid EPRA solar license, one of which must be T3	Diploma	5	
			Experience 5 – 10 years	5	
			Experience 1-4 years	4	
			Certificate	3	
			Experience 5 - 10years	3	

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				Experience 1-4years	2
	4	Financial Capacity (Maximum marks) 15	Audited Accounts – financial capability of the firm based on information provided in the last three years audited accounts i.e. 2019, 2020 and 2021 (2 marks for each year)		6
			Current Ratio = Current Assets/Current liabilities (a ratio of 1 and above (2 marks for the three years audited), Below 1 (1 mark for the three years audited)		2
			Line of credit of over Ksh 5 Million.		3
			Annual volume (turn over) of construction work for the successful tenderer in any of the last two years shall be:	5 Million and above	2
				Below 5million	1
			Bank statement (last six months to date of tender)	Six months and above	2
				2-5months	1
		Proposed program (work methodology and schedule) Maximum marks - 10			10
				TOTAL	100 Marks
		Only bidders who score 70% and above will be subject to financial evaluation. Those who score below 70% will be eliminated at this stage from the entire evaluation process and will not be considered further.			
		The Procuring Entity will verify information submitted. Any form of forgery or misinformation will lead to disqualification of the bid.			
	Financial Evaluation.				
	Prices will be analyzed and the lowest evaluated responsive bidder will be recommended for award as per the Public Procurement and Assets Disposal Act, 2015				
17.1	The currency in which the prices shall be quoted shall be: Kenyan Shilling				

3.3 STANDARD FORMS

- Letter of Application

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- Tender Questionnaire
- Declaration Form
- Confidential Business Questionnaire
- Statement of Foreign Currency Requirement
- Form of Tender
- Appendix to Form of Tender
- Manufacturer Warranty
- Manufacturer Authorization
- Letter of Acceptance
- Form of Agreement
- Form of Tender Security
- Performance Bank Guarantee (unconditional)
- Bank Guarantee for Advance Payment
- Letter of Notification of Award

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3.3.1 TENDERER'S QUALIFICATION WITHOUT PRE-QUALIFICATION

To establish its qualifications to perform the contract in accordance with Section III, Evaluation and Qualification Criteria the Tenderer shall provide the information requested in the corresponding Information Sheets included hereunder.

3.3.2 FORM ELI -1.1: Tenderer Information Form

Date: _____

ITT No. and title: _____

Tenderer's name
In case of Joint Venture (JV), name of each member:
Tenderer's actual or intended country of registration: <i>[indicate country of Constitution]</i>
Tenderer's actual or intended year of incorporation:
Tenderer's legal address [in country of registration]:
Tenderer's authorized representative information Name: _____ Address: _____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents of ☐ Articles of Incorporation (or equivalent documents of constitution or association), and/or documents of registration of the legal entity named above, in accordance with ITT 3.6 ☐ In case of JV, letter of intent to form JV or JV agreement, in accordance with ITT 3.5 ☐ In case of state-owned enterprise or institution, in accordance with ITT 3.8, documents establishing: • Legal and financial autonomy • Operation under commercial law • Establishing that the Tenderer is not under the supervision of the Procuring Entity
2. Included are the organizational chart, a list of Board of Directors, and the beneficial ownership.

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3.3.3 FORM ELI -1.2: Tenderer's JV Information Form
(to be completed for each member of Tenderer's JV)

Date: _____

ITT No. and title: _____

Tenderer'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: _____
1. Attached are copies of original documents of ☐ Articles of Incorporation (or equivalent documents of constitution or association), and/or registration documents of the legal entity named above, in accordance with ITT 3.6. ☐ In case of a state-owned enterprise or institution, documents establishing legal and financial autonomy, operation in accordance with commercial law, and that they are not under the supervision of the Procuring Entity, in accordance with ITT 3.8. 2. Included are the organizational chart, a list of Board of Directors, and the beneficial ownership.

3.3.4 DETAILS OF SUB-CONTRACTORS

If the Tenderer wishes to sublet any portions of the Works under any heading, he must give below details of the sub-contractors he intends to employ for each portion.

Failure to comply with this requirement may invalidate the tender.

1. Portion of Works to be sublet:

Full name of Sub-contractor and address of head office:

Sub-contractor's experience of similar works carried out in the last 3 years with

Contract value.....

.....

.....

2. Portion of Works to be sublet:

Full name of Sub-contractor and address of head office:

Sub-contractor's experience of similar works carried out in the last 3 years with

Contract value.....

.....

.....

[Signature of Tenderer]

Date

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3.3.5 FORM CON – 2

Historical Contract Non-Performance, Pending Litigation and Litigation History

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Non-Performed Contracts in accordance with Section III, Evaluation and Qualification Criteria			
☐ Contract non-performance did not occur since 1 st January <i>[insert year]</i> specified in Section III, Evaluation and Qualification Criteria, Sub-Factor 2.1.			
☐ Contract(s) not performed since 1 st January <i>[insert year]</i> specified in Section III, Evaluation and Qualification Criteria, requirement 2.1			
Year	Non-performed portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and Kenya Shilling equivalent)
<i>[insert year]</i>	<i>[insert amount and percentage]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Procuring Entity: <i>[insert full name]</i> Address of Procuring Entity: <i>[insert street/city/country]</i> Reason(s) for nonperformance: <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>
Pending Litigation, in accordance with Section III, Evaluation and Qualification Criteria			
☐ No pending litigation in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.3.			
☐ Pending litigation in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.3 as indicated below.			

Year of dispute	Amount in dispute (currency)	Contract Identification	Total Contract Amount (currency), Kenya Shilling Equivalent (exchange rate)
		Contract Identification: _____ Name of Procuring Entity: _____ Address of Procuring Entity: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	

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		Contract Identification: Name of Procuring Entity: Address of Procuring Entity: Matter in dispute: Party who initiated the dispute: Status of dispute:	
Litigation History in accordance with Section III, Evaluation and Qualification Criteria ☐ No Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.4. ☐ Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.4 as indicated below.			
Year of award	Outcome as percentage of Net Worth	Contract Identification	Total Contract Amount (currency), Kenya Shilling Equivalent (exchange rate)
<i>[insert year]</i>	<i>[insert percentage]</i>	Contract Identification: <i>[indicate complete contract name, number, and any other identification]</i> Name of Procuring Entity: <i>[insert full name]</i> Address of Procuring Entity: <i>[insert street/city/country]</i> Matter in dispute: <i>[indicate main issues in dispute]</i> Party who initiated the dispute: <i>[indicate "Procuring Entity" or "Contractor"]</i> Reason(s) for Litigation and award decision <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>

3.3.6 FORM FIN – 3.1: Financial Situation and Performance

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

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3.3.6.1 Financial Data

Type of Financial information in _____ (currency)	Historic information for previous _____ years, in _____ (amount in currency, currency, exchange rate*, USD equivalent)				
	Year 1	Year 2	Year 3	Year 4	Year 5
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					

*Refer to ITT 15 for the exchange rate

3.3.6.2 Sources of Finance

Specify sources of finance to meet the cash flow requirements on works currently in progress and for future contract commitments.

No.	Source of finance	Amount (Kenya Shilling equivalent)
1		
2		
3		

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3.3.6.3 Financial documents

The Tenderer and its parties shall provide copies of financial statements for _____ years pursuant Section III, Evaluation and Qualifications Criteria, Sub-factor 3.1. The financial statements shall:

- (a) reflect the financial situation of the Tenderer or in case of JV member, and not an affiliated entity (such as parent company or group member).
 - (b) 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 _____ years required above; and complying with the requirements

¹ If the most recent set of financial statements is for a period earlier than 12 months from the date of Tender, the reason for this should be justified.

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3.3.7 FORM FIN – 3.2: Average Annual Construction Turnover

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

		Annual turnover data (construction only)	
Year	Amount Currency	Exchange rate	Kenya Shilling equivalent
<i>[indicate year]</i>	<i>[insert amount and indicate currency]</i>		
Average Annual Construction Turnover *			

* See Section III, Evaluation and Qualification Criteria, Sub-Factor 3.2.

3.3.8 FORM FIN – 3.3: 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 Section III, Evaluation and Qualification Criteria

Financial Resources		
No.	Source of financing	Amount (Kenya Shilling equivalent)
1		
2		
3		

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3.3.9 FORM FIN – 3.4: Current Contract Commitments / Works in Progress

Tenderers 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	Procuring Entity's Contact Address, Tel,	Value of Outstanding Work [Current Kenya Shilling /month Equivalent]	Estimated Completion Date	Average Monthly Invoicing Over Last Six Months [Kenya Shilling /month]
1					
2					
3					
4					
5					

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3.3.10 FORM EXP - 4.1: General Construction Experience

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Page _____ of _____ pages

Starting Year	Ending Year	Contract Identification	Role of Tenderer
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	

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3.3.11 FORM EXP - 4.2(a): Specific Construction and Contract Management Experience

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Similar Contract No.	Information			
Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor ☐	Member in JV ☐	Management Contractor ☐	Sub-contractor ☐
Total Contract Amount	Kenya Shilling			
If member in a JV or sub-contractor, specify participation in total Contract amount				
Procuring Entity's Name:				
Address:				
Telephone/fax number				
E-mail:				

3.4 QUALIFICATION FORMS

3.4.1 FORM EQU: EQUIPMENT

The Tenderer shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Tenderer.

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	

Omit the following information for equipment owned by the Tenderer.

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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	

3.4.2 Contractor's Representative and Key Personnel Schedule

Tenderers should provide the names and details of the suitably qualified Contractor's Representative and Key Personnel to perform the Contract. The data on their experience should be supplied using the Form PER-2 below for each candidate.

3.4.3 Contractor' Representative and Key Personnel

3.4.3.1 FORMPER-1

1.	Title of position: (Contractor's Representative)	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
2.	Title of position: <i>[insert title]</i>	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>

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	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
3.	Title of position: <i>[insert title]</i>	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
4.	Title of position: <i>[insert title]</i>	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
5.	Title of position: <i>[insert title]</i>	
	Name of candidate	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>

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3.4.3.2 FORM PER-2:

Resume and Declaration - Contractor's Representative and Key Personnel.

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Name of Tenderer		
Position [#1]: <i>[title of position from Form PER-1]</i>		
Personnel information	Name:	Date of birth:
	Address:	E-mail:
	Professional qualifications:	
	Academic qualifications:	
	Language proficiency: <i>[language and levels of speaking, reading and writing skills]</i>	
Details		
	Address of Procuring Entity:	
	Telephone:	Contact (manager / personnel officer):
	Fax:	
	Job title:	Years with present Procuring Entity:

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Project	Role	Duration of involvement	Relevant experience
<i>[main project details]</i>	<i>[role and responsibilities on the project]</i>	<i>[time in role]</i>	<i>[describe the experience relevant to this position]</i>

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Declaration

I, the undersigned *[insert either "Contractor's Representative" or "Key Personnel" as applicable]*, certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Tender:

Commitment	Details
Commitment to duration of contract:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>
Time commitment:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>

I understand that any misrepresentation or omission in this Form may:

- a) be taken into consideration during Tender evaluation;
- b) result in my disqualification from participating in the Tender;
- c) result in my dismissal from the contract.

Name of Contractor's Representative or Key Personnel: *[insert name]*

Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Tenderer:

Signature: _____

Date: (day month year): _____

3.5 OTHER FORMS

3.5.1 FORM OF TENDER

INSTRUCTIONS TO TENDERERS

- i) *The Tenderer must prepare this Form of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and business address.*
- ii) *All italicized text is to help Tenderer in preparing this form.*
- iii) *Tenderer must complete and sign CERTIFICATE OF INDEPENDENT TENDER DETERMINATION and the SELF DECLARATION OF THE TENDERER attached to this Form of Tender.*
- iv) *The Form of Tender shall include the following Forms duly completed and signed by the Tenderer.*
 - *Tenderer's Eligibility- Confidential Business Questionnaire*
 - *Certificate of Independent Tender Determination*
 - *Self-Declaration of the Tenderer*

Date of this Tender submission: *[insert date (as day, month and year) of Tender submission]*

Request for Tender No.: *[insert identification]*

Name and description of Tender *[Insert as per ITT]*

Alternative No.: *[insert identification No if this is a Tender for an alternative]*

To: *[insert complete name of Procuring Entity]*

Dear Sirs,

- 1) In accordance with the Conditions of Contract, Specifications, Drawings and Bills of Quantities for the execution of the above named Works, we, the undersigned offer to construct and complete the Works and remedy any defects therein for the sum of Kenya Shillings *[[Amount in figures]*
_____ Kenya Shillings *[amount in words]*

_____.

The above amount includes foreign currency amount (s) of *[state figure or a percentage and currency]* *[figures]* _____ *[words]* _____
_____.

The percentage or amount quoted above does not include provisional sums, and only allows not more than two foreign currencies.

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- 2) We undertake, if our tender is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Project Manager's notice to commence, and to complete the whole of the Works comprised in the Contract within the time stated in the Special Conditions of Contract.
- 3) We agree to adhere by this tender until _____[Insert date], and it shall remain binding upon us and may be accepted at any time before that date.
- 4) Unless and until a formal Agreement is prepared and executed this tender together with your written acceptance thereof, shall constitute a binding Contract between us. We further understand that you are not bound to accept the lowest or any tender you may receive.
- 5) We, the undersigned, further declare that:
- i) No reservations: We have examined and have no reservations to the tender document, including Addenda issued in accordance with ITT 28;
 - ii) Eligibility: We meet the eligibility requirements and have no conflict of interest in accordance with ITT 3 and 4;
 - iii) Tender-Securing Declaration: We have not been suspended nor declared ineligible by the Procuring Entity based on execution of a Tender-Securing or Proposal-Securing Declaration in the Procuring Entity's Country in accordance with ITT 19.8;
 - iv) Conformity: We offer to execute in conformity with the tendering documents and in accordance with the implementation and completion specified in the construction schedule, the following Works: *[insert a brief description of the Works]*;
 - v) Tender Price: The total price of our Tender, excluding any discounts offered in item 1 above is: *[Insert one of the options below as appropriate]*
 - vi) Option 1, in case of one lot: Total price is: *[insert the total price of the Tender in words and figures, indicating the various amounts and the respective currencies]*;

Or

Option 2, in case of multiple lots:

- a) Total price of each lot *[insert the total price of each lot in words and figures, indicating the various amounts and the respective currencies]*; _____
- b) And Total price of all lots (sum of all lots) *[insert the total price of all lots in words and figures, indicating the various amounts and the respective currencies]*; _____
- vii) Discounts: The discounts offered and the methodology for their application are:
The discounts offered are: *[Specify in detail each discount offered.]* _____

The exact method of calculations to determine the net price after application of discounts is shown below: *[Specify in detail the method that shall be used to apply the discounts]*; _____

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- viii) **Tender Validity Period:** Our Tender shall be valid for the period specified in TDS 18.1 (as amended, if applicable) from the date fixed for the Tender submission deadline specified in TDS 22.1 (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- ix) **Performance Security:** If our Tender is accepted, we commit to obtain a Performance Security in accordance with the Tendering document;
- x) **One Tender Per Tender:** We are not submitting any other Tender(s) as an individual Tender, and we are not participating in any other Tender(s) as a Joint Venture member or as a subcontractor, and meet the requirements of ITT 3.4, other than alternative Tenders submitted in accordance with ITT 13.3;
- xi) **Suspension and Debarment:** We, along with any of our subcontractors, suppliers, Project Manager, manufacturers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Public Procurement Regulatory Authority or any other entity of the Government of Kenya, or any international organization.
- xii) **State-owned enterprise or institution:** *[select the appropriate option and delete the other]* *[We are not a state-owned enterprise or institution]* / *[We are a state-owned enterprise or institution but meet the requirements of ITT 3.8];*
- xiii) **Commissions, gratuities, fees:** We have paid, or will pay the following commissions, gratuities, or fees with respect to the tender process or execution of the Contract: *[insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity].*

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate “none.”)

- xiv) **Binding Contract:** We understand that this Tender, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;
- xv) **Not Bound to Accept:** We understand that you are not bound to accept the lowest evaluated cost Tender, the Most Advantageous Tender or any other Tender that you may receive;
- xvi) **Fraud and Corruption:** We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf engages in any type of Fraud and Corruption;
- xvii) **Collusive practices:** We hereby certify and confirm that the tender is genuine, non-collusive and made with the intention of accepting the contract if awarded. To this effect we have signed the “Certificate of Independent Tender Determination” attached below.
- xviii) We undertake to adhere by the Code of Ethics for Persons Participating in Public Procurement and Asset Disposal, copy available from *(specify website)* during the procurement process and the execution of any resulting contract.
- xix) We, the Tenderer, have completed fully and signed the following Forms as part of our Tender:
- Tenderer's Eligibility; Confidential Business Questionnaire – to establish we are not in any conflict to interest.

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- b) Self-Declaration of the Tenderer – to declare that we will, if awarded a contract, not engage in any form of fraud and corruption.
- c) Declaration and commitment to the Code of Ethics for Persons Participating in Public Procurement and Asset Disposal

Further, we confirm that we have read and understood the full content and scope of fraud and corruption as informed in “**Appendix 1- Fraud and Corruption**” attached to the Form of Tender.

Name of the Tenderer: **[insert complete name of person signing the Tender]*

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: ***[insert complete name of person duly authorized to sign the Tender]*

Title of the person signing the Tender: *[insert complete title of the person signing the Tender]*

Signature of the person named above: *[insert signature of person whose name and capacity are shown above]* **Date signed** *[insert date of signing]* day of *[insert month]*, *[insert year]*

Date signed _____ day of _____, _____

Notes

** In the case of the Tender submitted by joint venture specify the name of the Joint Venture as Tenderer*

*** Person signing the Tender shall have the power of attorney given by the Tenderer to be attached with the Tender.*

3.5.2 TENDERER'S ELIGIBILITY- CONFIDENTIAL BUSINESS QUESTIONNAIRE

3.5.2.1 Instruction to Tenderer

Tender is instructed to complete the particulars required in this Form, *one form for each entity if Tender is a JV*. Tenderer is further reminded that it is an offence to give false information on this Form.

a) Tenderer's details

	ITEM	DESCRIPTION
1	Name of the Procuring Entity	
2	Reference Number of the Tender	
3	Date and Time of Tender Opening	
4	Name of the Tenderer	
5	Full Address and Contact Details of the Tenderer.	1. Country 2. City 3. Location 4. Building 5. Floor 6. Postal Address 7. Name and email of contact person.
6	Current Trade License Registration Number and Expiring date	
7	Name, country and full address (<i>postal and physical addresses, email, and telephone number</i>) of Registering Body/Agency	
8	Description of Nature of Business	
9	Maximum value of business which the Tenderer handles.	
10	State if Tenders Company is listed in stock exchange, give name and full address (<i>postal and physical addresses, email, and telephone number</i>) of state which stock exchange	

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General and Specific Details

b) Sole Proprietor, provide the following details.

Name in full _____ Age _____
Nationality _____ Country of Origin _____
Citizenship _____

c) Partnership, provide the following details.

	Names of Partners	Nationality	Citizenship	% Shares owned
1				
2				
3				

d) Registered Company, provide the following details.

a. Private or public Company _____

b. State the nominal and issued capital of the Company _____ Nominal Kenya
Shillings (Equivalent).....
Issued Kenya Shillings
(Equivalent).....

c. Give details of Directors as follows.

	Names of Director	Nationality	Citizenship	% Shares owned
1				
2				
3				

e) DISCLOSURE OF INTEREST- Interest of the Firm in the Procuring Entity.

i) Are there any person/persons in (Name of Procuring Entity)
who has/have an interest or relationship in this firm? Yes/No.....

If yes, provide details as follows.

	Names of Person	Designation in the Procuring Entity	Interest or Relationship with Tenderer
1			
2			
3			

Conflict of interest disclosure

	Type of Conflict	Disclosure YES OR NO	If YES provide details of the relationship with Tenderer
1	Tenderer is directly or indirectly controls, is controlled by or is under common control with another tenderer.		
2	Tenderer receives or has received any direct or indirect subsidy from another tenderer.		
3	Tenderer has the same legal representative as another tenderer		
4	Tender has a relationship with another tenderer, directly or through common third parties, that puts it in a position to influence the tender of another tenderer, or influence the decisions of the Procuring Entity regarding this tendering process.		
5	Any of the Tenderer's affiliates participated as a consultant in the preparation of the design or technical specifications of the works that are the subject of the tender.		
6	Tenderer would be providing goods, works, non-consulting services or consulting services during implementation of the contract specified in this Tender Document.		
7	Tenderer has a close business or family relationship with a professional staff of the Procuring Entity who are directly or indirectly involved in the preparation of the Tender document or specifications of the Contract, and/or the Tender evaluation process of such contract.		
8	Tenderer has a close business or family relationship with a professional staff of the Procuring Entity who would be involved in the implementation or supervision of the such Contract.		
9	Has the conflict stemming from such relationship stated in item 7 and 8 above been resolved in a manner acceptable to the Procuring Entity throughout the tendering process and execution of the Contract.		

f) Certification

On behalf of the Tenderer, I certify that the information given above is complete, current and accurate as at the date of submission.

Full Name _____

Title or Designation _____

(Signature)

(Date)

3.5.3 SELF - DECLARATION FORMS

FORM SD1

SELF DECLARATION THAT THE PERSON/TENDERER IS NOT DEBARRED IN THE MATTER OF THE PUBLIC PROCUREMENT AND ASSET DISPOSAL ACT 2015.

I,, of Post Office Box being a
resident of in the Republic of do
hereby make a statement as follows: -

1. THAT I am the Company Secretary/ Chief Executive/Managing Director/Principal
Officer/Director of
..... (*insert name of the Company*) who is a Bidder in
respect of Tender No. for
.....
..... (*insert tender
title/description*) for (*insert name of the Procuring entity*) and duly
authorized and competent to make this statement.
2. THAT the aforesaid Bidder, its Directors and subcontractors have not been debarred
from participating in procurement proceeding under Part IV of the Act.
3. THAT what is deposed to herein above is true to the best of my knowledge, information
and belief.

.....
(Title) (Signature) (Date)

Bidder Official Stamp

FORM SD2

**3.5.3.1 SELF DECLARATION THAT THE PERSON/TENDERER WILL NOT ENGAGE IN ANY CORRUPT OR
FRAUDULENT PRACTICE**

I, of P. O. Box being a resident of
..... in the Republic of do hereby make a statement as follows: -

1. THAT I am the Chief Executive/Managing Director/Principal Officer/Director of
(*insert name of the Company*) who is a Bidder in respect of Tender No.
..... for
..... (*insert tender title/description*) for (*insert name of the Procuring
entity*) and duly authorized and competent to make this statement.
2. THAT the aforesaid Bidder, its servants and/or agents /subcontractors will not engage in any corrupt
or fraudulent practice and has not been requested to pay any inducement to any member of the Board,
Management, Staff and/or employees and/or agents of (*insert name of the
Procuring entity*) which is the procuring entity.
3. THAT the aforesaid Bidder, its servants and/or agents /subcontractors have not offered any
inducement to any member of the Board, Management, Staff and/or employees and/or agents of
..... (name of the procuring entity)
4. THAT the aforesaid Bidder will not engage /has not engaged in any corrosive practice with other
bidders participating in the subject tender
5. THAT what is deponed to herein above is true to the best of my knowledge information and belief.

.....
(Title) (Signature) (Date)

Bidder's Official Stamp

3.5.3.2 DECLARATION AND COMMITMENT TO THE CODE OF ETHICS

I (person) on behalf of (*Name of the Business/ Company/Firm*) declare that I have read and fully understood the contents of the Public Procurement & Asset Disposal Act, 2015, Regulations and the Code of Ethics for persons participating in Public Procurement and Asset Disposal and my responsibilities under the Code.

I do hereby commit to abide by the provisions of the Code of Ethics for persons participating in Public Procurement and Asset Disposal.

Name of Authorized signatory.....

Sign.....

Position.....

.....

Office address.....

Telephone..... E-

mail.....

...

Name of the

Firm/Company.....

Date..... (Company Seal/

Rubber Stamp where applicable)

Witness

Name Sign.....

Date.....

3.5.4 APPENDIX 1- FRAUD AND CORRUPTION

(Appendix 1 shall not be modified)

3.5.4.1 Purpose

The Government of Kenya's Anti-Corruption and Economic Crime laws and their sanction's policies and procedures, Public Procurement and Asset Disposal Act (*no. 33 of 2015*) and its Regulation, and any other Kenya's Acts or Regulations related to Fraud and Corruption, and similar offences, shall apply with respect to Public Procurement Processes and Contracts that are governed by the laws of Kenya.

3.5.4.2 Requirements

The Government of Kenya requires that all parties including Procuring Entities, Tenderers, (applicants/proposers), Consultants, Contractors and Suppliers; any Sub-contractors, Sub-consultants, Service providers or Suppliers; any Agents (whether declared or not); and any of their Personnel, involved and engaged in procurement under Kenya's Laws and Regulation, observe the highest standard of ethics during the procurement process, selection and contract execution of all contracts, and refrain from Fraud and Corruption and fully comply with Kenya's laws and Regulations as per paragraphs 1.1 above.

Kenya's public procurement and asset disposal act (*no. 33 of 2015*) under Section 66 describes rules to be followed and actions to be taken in dealing with Corrupt, Coercive, Obstructive, Collusive or Fraudulent practices, and Conflicts of Interest in procurement including consequences for offences committed. A few of the provisions noted below highlight Kenya's policy of no tolerance for such practices and behavior: -

- 1) a person to whom this Act applies shall not be involved in any corrupt, coercive, obstructive, collusive or fraudulent practice; or conflicts of interest in any procurement or asset disposal proceeding;
- 2) A person referred to under subsection (1) who contravenes the provisions of that sub-section commits an offence;
- 3) Without limiting the generality of the subsection (1) and (2), the person shall be: -
 - a) disqualified from entering into a contract for a procurement or asset disposal proceeding; or
 - b) if a contract has already been entered into with the person, the contract shall be voidable;
- 4) The voiding of a contract by the procuring entity under subsection (7) does not limit any legal remedy the procuring entity may have;
- 5) An employee or agent of the procuring entity or a member of the Board or committee of the procuring entity who has a conflict of interest with respect to a procurement: -
 - a) shall not take part in the procurement proceedings;
 - b) shall not, after a procurement contract has been entered into, take part in any decision relating to the procurement or contract; and
- c) shall not be a subcontractor for the bidder to whom was awarded contract, or a member of the group of bidders to whom the contract was awarded, but the subcontractor appointed shall meet all the requirements of this Act.
- 6) An employee, agent or member described in subsection (1) who refrains from doing anything prohibited under that subsection, but for that subsection, would have been within his or her duties shall disclose the conflict of interest to the

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procuring entity;

- 7) If a person contravenes subsection (1) with respect to a conflict of interest described in subsection (5)(a) and the contract is awarded to the person or his relative or to another person in whom one of them had a direct or indirect pecuniary interest, the contract shall be terminated and all costs incurred by the public entity shall be made good by the awarding officer. Etc.

In compliance with Kenya's laws, regulations and policies mentioned above, the Procuring Entity:

- a) Defines broadly, for the purposes of the above provisions, the terms set forth below as follows:
- i) "corrupt practice" is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;
 - ii) "fraudulent practice" is any act or omission, including misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain financial or other benefit or to avoid an obligation;
 - iii) "collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
 - iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
 - v) "obstructive practice" is:
 - deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede investigation by Public Procurement Regulatory Authority (PPRA) or any other appropriate authority appointed by Government of Kenya into allegations of a corrupt, fraudulent, coercive, or collusive practice; and/or threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or
 - acts intended to materially impede the exercise of the PPRA's or the appointed authority's inspection and audit rights provided for under paragraph 2.3 e. below.
- b) Defines more specifically, in accordance with the above procurement Act provisions set forth for fraudulent and collusive practices as follows:
- "fraudulent practice" includes a misrepresentation of fact in order to influence a procurement or disposal process or the exercise of a contract to the detriment of the procuring entity or the tenderer or the contractor, and includes collusive practices amongst tenderers prior to or after tender submission designed to establish tender prices at artificial non-competitive levels and to deprive the procuring entity of the benefits of free and open competition.
- c) Rejects a proposal for award¹ of a contract if PPRA determines that the firm or individual recommended for award, any of its personnel, or its agents, or its sub-consultants, 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 in question;
- d) Pursuant to the Kenya's above stated Acts and Regulations, may sanction or

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recommend to appropriate authority (ies) for sanctioning and debarment of a firm or individual, as applicable under the Acts and Regulations;

- e) Requires that a clause be included in Tender documents and Request for Proposal documents requiring (i) Tenderers (applicants/proposers), Consultants, Contractors, and Suppliers, and their Sub-contractors, Sub-consultants, Service providers, Suppliers, Agents personnel, permit the PPRA or any other appropriate authority appointed by Government of Kenya to inspect² all accounts, records and other documents relating to the procurement process, selection and/or contract execution, and to have them audited by auditors appointed by the PPRA or any other appropriate authority appointed by Government of Kenya; and
- f) Pursuant to Section 62 of the above Act, requires Applicants/Tenderers to submit along with their Applications/Tenders/Proposals a "Self-Declaration Form" as included in the procurement document declaring that they and all parties involved in the procurement process and contract execution have not engaged/will not engage in any corrupt or fraudulent practices.

3.5.5 FORM OF TENDER SECURITY-[Option 1–Demand Bank Guarantee]

Beneficiary:_____ Request forTenders No:____Date:_____ TENDER GUARANTEE
No. _____

Guarantor: _____

1. We have been informed that _____(here inafter called "the Applicant") has submitted or will submit to the Beneficiary its Tender (here inafter called" the Tender") for the execution of _____ under Request for Tenders No. _____("the ITT").
2. Furthermore, we understand that, according to the Beneficiary's conditions, Tenders must be supported by a Tender guarantee.
3. At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of(____) upon receipt by us of the Beneficiary's complying demand, supported by the Beneficiary's statement, whether in the demand itself or a separate signed document accompanying or identifying the demand, stating that either the Applicant:
 - (a) has withdrawn its Tender during the period of Tender validity set forth in the Applicant's Letter of Tender ("the Tender Validity Period"), or any extension thereto provided by the Applicant; or
 - b) having been notified of the acceptance of its Tender by the Beneficiary during the Tender Validity Period or any extension there to provided by the Applicant, (i) has failed to execute the contract agreement, or (ii) has failed to furnish the Performance.
4. This guarantee will expire: (a) if the Applicant is the successful Tenderer, upon our receipt of copies of the contract agreement signed by the Applicant and the Performance Security and, or (b) if the Applicant is not the successful Tenderer, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Tendering process; or (ii) thirty days after the end of the Tender Validity Period.

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5. Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

[signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

3.5.6 FORMAT OF TENDER SECURITY [Option 2–Insurance Guarantee]

TENDER GUARANTEE No.: _____

1. Whereas
[Name of the tenderer] (hereinafter called “the tenderer”) has submitted its tender dated
[Date of submission of tender] for the
[Name and/or description of the tender] (hereinafter called “the Tender”) for the execution of
under Request for Tenders No. _____ (“the ITT”).
2. KNOW ALL PEOPLE by these presents that WE of [**Name of Insurance Company**] having our registered office at (hereinafter called “the Guarantor”), are bound unto [Name of Procuring Entity] (hereinafter called “the Procuring Entity”) in the sum of (Currency and guarantee amount) for which payment well and truly to be made to the said Procuring Entity, the Guarantor binds itself, its successors and assigns, jointly and severally, firmly by these presents.
Sealed with the Common Seal of the said Guarantor this ____ day of _____ 20 ____.
3. NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Applicant:
 - a) has withdrawn its Tender during the period of Tender validity set forth in the Principal's Letter of Tender (“the Tender Validity Period”), or any extension thereto provided by the Principal; or
 - b) having been notified of the acceptance of its Tender by the Procuring Entity during the Tender Validity Period or any extension thereto provided by the Principal; (i) failed to execute the Contract agreement; or (ii) has failed to furnish the Performance Security, in accordance with the Instructions to tenderers (“ITT”) of the Procuring Entity's Tendering document.

then the guarantee undertakes to immediately pay to the Procuring Entity up to the above amount upon receipt of the Procuring Entity's first written demand, without the Procuring Entity having to substantiate its demand, provided that in its demand the Procuring Entity shall state that the demand arises from the occurrence of any of the above events, specifying which event(s) has occurred.

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4. This guarantee will expire: (a) if the Applicant is the successful Tenderer, upon our receipt of copies of the contract agreement signed by the Applicant and the Performance Security and, or (b) if the Applicant is not the successful Tenderer, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Tendering process; or (ii) twenty-eight days after the end of the Tender Validity Period.

5. Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

[Date]

[Signature of the Guarantor]

[Witness]

[Seal]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

3.5.1 TENDER-SECURING DECLARATION FORM

[The Bidder shall complete this Form in accordance with the instructions indicated]

Date:.....*[insert date (as day, month and year) of Tender Submission]*

Tender No.:.....*[insert number of tendering process]*

To:..... *[insert complete name of Purchaser]* I/We, the undersigned,

declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Tender-Securing Declaration.
2. I/We accept that I/we will automatically be suspended from being eligible for tendering in any contract with the Purchaser for the period of time of *[insert number of months or years]* starting on *[insert date]*, if we are in breach of our obligation(s) under the bid conditions, because we – (a) have withdrawn our tender during the period of tender validity specified by us in the Tendering Data Sheet; or (b) having been notified of the acceptance of our Bid by the Purchaser during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with the instructions to tenders.
3. I/We understand that this Tender Securing Declaration shall expire if we are not the successful Tenderer(s), upon the earlier of:
 - a) our receipt of a copy of your notification of the name of the successful Tenderer; or
 - b) thirty days after the expiration of our Tender.
4. I/We understand that if I am/we are/in a Joint Venture, the Tender Securing Declaration must be in the name of the Joint Venture that submits the bid, and the Joint Venture has not been legally constituted at the time of bidding, the Tender Securing Declaration shall be in the names of all future partners as named in the letter of intent.

Signed:.....

Capacity / title (director or partner or sole proprietor, etc.)

Name: Duly

authorized to sign the bid for and on behalf of: *[insert complete name of Tenderer]*

Dated on day of *[Insert date of signing]* Seal or stamp

4 SECTION VI – WORK REQUIREMENTS

1 WORKS SPECIFICATIONS AND EMPLOYER REQUIREMENTS

1.1 Site location

The project is located in Busia County, Funyula constituency, Rumbiye Sub-location, Rumbiye community. The project's focal point is the Rumbiye Primary School.

1.2 SCOPE

The scope of this specification covers the SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF A SOLAR POWERED WATER PUMPING SYSTEM TO EXISTING BOREHOLE LOCATED AT RUMBIYE SUB-LOCATION IN BUSIA COUNTY

The solar PV modules will be mounted on a structure which will be constructed as per the bill of quantities. However, all items required for the safe and efficient operation whether explicitly stated or not stated in this document shall be included by the contractor.

It is the responsibility of the bidder to supply and erect all items and all labour that are included and necessary for the completion of the work whether specifically mentioned or not.

1.3 Particular specifications of materials and works

1. BOREHOLE PARAMETERS	
PUMP INTAKE LEVEL (M)	156 M
BOREHOLE YIELD (M3/HR)	7.5 M3/HR
BOREHOLE DEPTH (M)	170 M
STATIC WATER LEVEL (M)	23.63 M
2. PUMPING STATION PARAMETERS	
BOREHOLE SITE ELEVATION	1221 MASL
ELEVATED TANK SITE ELEVATION	1280 MASL
TANK INTAKE ELEVATION	1284.3MASL
TOTAL PUMPING HEAD (STATIC)	63.3M
TOTAL PUMPING HEAD (STATIC + DYNAMIC)	70.3MASL
REQUIRED PUMP MOTOR POWER (KW)	7.5 KW
PUMP CAPACITY, Q, (M3/HR)	7.5 M3/HR
3. SOLAR PLANT PARAMETERS	
REQUIRED SOLAR CAPACITY (KW)	9.5 KW
PUMP POWER RATING (KW)	7.5 KW
INVERTER (KW)	7.5 KW
SOLAR PANELS SPECIFICATION	550 WATTS MONOCRYSTALLINE
NO. OF SOLAR PANELS	18 NR.
SOLAR MOUNTING STRUCTURE	3 METRE HIGH ALUMINIUM FRAMED STRUCTURE
4. WATER STORAGE AND RISING MAIN	
FLOW INTO THE TANK (M3/HR)	7.5 M3/HR
PROPOSED TANK	SURFACE PRESSED STEEL TANK
TANK CAPACITY (M3)	65 M3
TANK DIMENSIONS	4.88M X 3.66MM X 3.66M
TANK SUPPORT	Reinforced Concrete base slab and surface beams
DESIGNED RISING MAIN – PIPE TYPE	HDPE, PE 100, PN 8
DESIGNED RISING MAIN - DIAMETER (MM)	OD 63 MM
DESIGNED RISING MAIN - LENGTH (M)	350 M

1.4 ELECTRICAL INSTALLATIONS

1.4.1 General

This section covers the supply and installation of all electrical plant including all necessary calculations, technical details, catalogues, drawings, etc., for the plant, machinery, apparatus, systems, articles, and associated accessories.

The ratings of switchgear, electrical protection devices, cables, etc. shall be dependent upon the ratings and characteristics of the pumping sets and mechanical plant being supplied and the adopted method of motor starting. In this respect, it shall be deemed that the Contractor has considered this and has offered compatible electrical and mechanical components.

The final arrangement of switchboards, switchgear and motor control panels is dependent upon the plant offered and therefore subject to approval.

1.4.2 Regulations and Standards

The electrical installation shall comply with all relevant statutory regulations and standards current at date of tender, unless otherwise indicated within this Specification. In general the following shall apply:

- a) The IEE Regulations for Electrical Installations, 16th Edition
- b) The Health and Safety at Work Act, etc.
- c) Factories Act (UK)
- d) British Standards (BS) and International Standards stipulated in SSRN (Standard Specifications Reference Numbers)
- e) British Standards Codes of Practice (CP)
- f) International Electro-technical Commission (IEC)
- g) Regulations under the Electricity Acts of Kenya.

If no standard is specified, the relevant British Standard or, in the absence of such standard, International standard shall apply.

Note: A list of the Standard Specifications Reference Numbers (SSRN) is provided at the end of these Electrical and Mechanical specifications.

1.4.3 Abbreviations of Electrical Items

- R -red phase
- Y -yellow phase
- B -blue phase
- N -neutral
- ac -alternative current
- dc -direct current
- A -amp
- mA -milliamp
- V -volt
- kW - kilowatt
- kWh -kilowatt hour
- kVAr -kilovar
- MVA -megavolt amp

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- Hz -hertz (cycles per second)
- SP -single pole
- SPN -single pole and neutral
- DP -double pole
- TP -triple pole
- TPN -triple pole and neutral
- SPSwN -single pole and switched neutral
- TPSwN -triple pole and switched neutral
- MCB -miniature circuit breaker
- MCCB -moulded case circuit breaker
- RCD -residual current device
- MCC -motor control center

1.4.4 Polarity

The polarity of all electrical apparatus used for the Works specified shall be arranged as follows:

- for two pole apparatus the phase of 'live' pole at the top (or left hand side) and the neutral or 'earthed' pole at the bottom (or right hand side),
- for three or four pole apparatus the phases in order of red, yellow, blue and neutral reading from top to bottom or left to right in the case of vertical and horizontal layouts respectively and as viewed from the front.

All non-flexible cables shall be so connected between main switchboards, distribution boards, plant and accessories so that the correct sequence or phase colours are preserved throughout the system.

All non-flexible cable cores shall be identified with phase colours for three and four wire circuits. Single-phase circuits shall be red and black.

1.4.5 Voltage and supply system

The electric supplies to the sites are provided by The Kenya Power and Lighting Company (KP) and will, in general, be 33 kV, three phases, three wires, 50 Hz stepped down through suitably rated transformers to 3.3 kV for the pump motors and to 415V/240 V for distribution and reticulation to the various installations.

1.4.6 HV switchgear

HV switchgear shall generally conform to BS EN 60265-1:1998, IEC 60265-1:1998, BS EN 62271-100:2001, IEC 62271-100:2001, or BS EN 60298:1996, IEC 60298:1990 as appropriate. Switchgear shall be either air-break or vacuum type in accordance with the following requirements and details contained within the particular Specifications.

1.4.6.1 Air break isolators

Air break isolators shall generally be restricted to pole mounted switches or fused switches and shall comply with BS EN 60129:1994, IEC 60129:1984 and ASTA certified.

Switches shall be supplied and installed complete with all necessary insulators, coupling tubes, drive rods and manually operated mechanisms and shall be capable of accommodating solid links or expulsion or current limiting fuse links in spring loaded carriers. Fuses shall conform to BS EN 60282-1:2002 and shall be of the fast blow type.

Switches shall be capable of being locked in either the ON or OFF position. The switches shall be suitable for operation at the relevant ambient conditions and shall be rated to suit the maximum working voltage, load current and normal fault conditions of the system to which they are fitted. Switches shall be capable of breaking full load current and making online or transformer charging current.

Three phase switches shall be mechanically coupled to ensure simultaneous switching action of all the three units.

Expected normal characteristic ranges are as follows:

- working voltage 11 - 33k V
- current rating 400 A
- fault level 47 kA

1.4.6.2 HV and LV motor control cubicles - general requirements

In addition to the electrical protection specified elsewhere herein, safety cut-outs for both HV and LV control cubicles and switchgear shall be provided to protect against any operating conditions which could arise and which would be liable to cause damage to the plant, for example lack of water at pump suctions.

Motor protection relays for electric motors above 100 kW shall be of the electronic composite type. The relay shall incorporate the following protection within the composite unit:

- wide range adjustable over-current;
- overload;
- phase failure;
- under voltage;
- IDMT and earth fault;
- single phasing and successive start protection.

The operating push buttons, switches or handles of all circuit breakers, motor starters, isolators, etc., whether HV or LV shall be located on the front of cubicles, or for cubicles of the desk type, on the face of the desk. There shall be visual indications of the "ON" and "OFF" positions.

All operations of fault and alarm circuits shall be clearly and individually indicated by lamps on the fascia of the switchboard.

Fault and alarm lights shall remain on until the associated fault or alarm condition has been cleared and the system reset.

An audible alarm shall also be provided to indicate operation of any major fault or alarm function. Acknowledgement of the major fault or alarm condition shall also cancel the audible alarm.

Indicating lamps shall incorporate a lamp test feature with either individual push to test or a common lamp test button.

Push buttons fitted on the panel shall be of the shrouded type, unless otherwise specified, and shall have a label indicating their function.

Indicating lamps on panels shall be rated to withstand not less than 20% continuous over voltage and shall be so designed that the heat from the bulb does not discolor the cubicle.

Indicating lamps and push buttons shall be colored in accordance with IEC 73:

	<u>Indicating lamps</u>	<u>Color</u>
On		Red
Off		Green

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Fault	Yellow/amber
Alarms	White/yellow
Heaters	Blue

<u>Push buttons</u>	<u>Color</u>
Start	Green
Stop	Red
Alarm accept acknowledgement and mute	Black
Emergency stop	Red

All electrical indicating instruments shall comply with BS 3693, be of the moving iron type and to Class 1.5 or better. Instrument size shall be 96mm square with quadrant scale.

Instruments shall be flush mounted on the cubicles and effectively sealed against ingress of moisture, dust and insects. Instrument mounting height shall not exceed

1.80 meters above floor level. Unless otherwise specified instrument full-scale deflection shall be at least 120% of the normal operating point (i.e. nominal voltage or full load current).

Ammeters in motor circuits shall be capable of withstanding the starting current of the motors and shall have a compressed overload scale for this purpose. The full load current shall be defined with a red line. Voltmeter scales shall have a red line indicating normal voltage.

All voltage circuits of instruments shall be protected by a fuse in each unearthed phase, situated as close as practicable to the point of connection.

Current transformers (Cuts) shall have short circuit ratings not less than those of the circuits with which they are concerned, and shall fully comply with BS EN 60044- 1:1999, IEC 60044-1:1996

The secondary winding of all current transformers shall be earthed. The rated burden of each CT shall be a minimum of 150% of the designed load burden.

Where specified, capacitors for correcting power factor shall be incorporated in the panel. Such capacitors shall comply fully with BS EN 60831-1:1998, IEC 60831- 1:1996 and BS EN 60871-1:1998, IEC 60871-1:1997 as appropriate

All motors shall be provided with emergency stop push buttons mounted on or adjacent to the motors that shall lock out the control circuit and shall require a key to reset the circuit.

Control wiring for both HV and LV motor control panels, switchgear, etc., shall be 600V grade PVC or XLPE insulated multi-stranded copper wire to BS 6004:2000 or BS 6007:2000. The minimum size shall be 1.5mm² stranded conductors

All terminals shall be referenced and detailed on the schematic diagrams to be submitted to The Engineer.

It shall be possible to gain access to any terminal of any component so as to be able to remove and replace the wire from that terminal without recourse to special tools, and without the need to disturb other components.

All wiring shall be neatly run bunched in neat forms. All wiring accessories of plastic material, such as cleats, conduits, strapping, etc., shall be non-corrodible and resistant to flame propagation.

Crimped pin extensions shall be fitted to all control circuit cables to prevent wandering strands before being inserted into Klippon type terminal blocks.

Cabling shall enter the panel from above or below as applicable and as specified elsewhere in the Specifications. Cables shall be terminated using external boxes or internal gland plates.

Where necessary cable tray work shall be provided for supporting and fixing cables and full glanding and terminating facilities shall be provided. Gland plates shall be mounted not less

than 150mm above the cubicle bottom. It shall be possible to terminate all cables without requiring access to live interiors.

Primary cabling shall be completely isolated from all control wiring, etc., and auxiliary terminals shall be likewise isolated from primary terminals.

All terminal boards and terminal blocks shall be of a type providing a positive mechanical clamp on connection. Terminals for the connection of all external cabling shall be situated near their respective gland plate and at a minimum distance of 300mm from it.

Separate terminals shall be provided for incoming and outgoing connections and not more than two wires shall be connected to any one terminal.

Incoming units for LV panels shall incorporate:

- triple pole main switch and fuse combination;
 - voltmeter with selector switch;
 - ammeter with selector switch.

Motor starter cubicles shall incorporate the following:

- ☐ for low voltage switchboards a main triple pole switch/fuses and contactor combination;
- ☐ for high voltage switchboards a main disconnecter/fuses and vacuum contactor combination.

Motor protection for low voltage motors shall comprise:

- ☐ adjustable thermal overload protection;
- ☐ under voltage and single phasing protection;
- ☐ over voltage protection.

Motor protection for high voltage motors shall comprise:

- ☐ over current and earth fault protection;
- ☐ unbalanced load protection;
- ☐ under voltage and phase failure protection;
- ☐ over voltage protection.

Power factor correction shall be provided for all motor circuits to satisfy the requirements specified.

Starting control plant incorporating all necessary contactors, timers, fuses, etc.

- ☐ one ammeter with phase selector switch;
- ☐ motor start/stop push buttons;
- ☐ motor auto/off/manual selector switch as necessary;
- ☐ on/off/fault indication lights;
- ☐ hours run counter.

Outgoing distribution units shall be:

- ☐ switch fuse combination or circuit breakers;
- ☐ 240 V socket outlet for test/maintenance purposes, separately fused and protected.

1.4.7 Cables

1.4.7.1 General

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This Section of the Specifications deals with the materials and types of cables that may be used along with termination and identification requirements for the cables. Full details, catalogues, etc., shall be submitted.

All cables supplied for use under the Contract shall be British Approvals Service for Electric Cables (BASES) approved and shall be manufactured to the following British Standards, as appropriate:

- BS 5308-1:1986 Instrumentation cables. Specification for polyethylene insulated cables;
- BS 5308-2:1986 Instrumentation cables. Specification for PVC insulated cables;
- BS 5467:1997 Specification for 600/1000 V and 1900/3300 V armored electric cables having thermosetting insulation;
- BS 6004:2000 Electric cables. PVC insulated, non-armored cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring;
- BS 6007:2000 Electric cables. Single core unsheathed heat resisting cables for voltages up to and including 450/750 V, for internal wiring;
- BS EN 60702-1:2002, IEC 60702-1:2002 Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Cables;
- BS 6346:1997 Specification for 600/1000 V and 1900/3300 V armored electric cables having PVC insulation;
- BS 6480:1988 Specification for impregnated paper-insulated lead or lead alloy sheathed electric cables of rated voltages up to and including 33000 V;
- BS 6500:2000 Electric cables. Flexible cords rated up to 300/500 V, for use with appliances and plant intended for domestic, office and similar environments.

The Contractor shall submit full descriptive pamphlets and technical literature of the types of cables and cable manufacturers offered.

Manufacturer's test certificates for multicore cables shall be submitted to the Engineer for approval before any cables are installed. All cables shall be accompanied by the manufacturer's original guarantee, and shall be delivered to Site in the original wrapping.

1.4.7.2 Materials and minimum sizes

Cables shall have standard copper conductors, with minimum cross sectional areas as follows:

- | | |
|---|---------------------|
| - Motor supply cables | 4mm ² |
| - Cabling to control devices external to switchboards | 2.5mm ² |
| - Telemetry control/digital signal cables | 0.75mm ² |
| - Domestic lighting | 1.5mm ² |
| - Domestic general power | 2.5mm ² |

The neutral core of a cable or the neutral cable of a circuit shall be of the same cross sectional area as the associated phase.

1.4.7.3 Paper-insulated, lead-sheathed cable

These cables shall be of the mass impregnated, non-draining type, to BS 6480 and shall only be required for use on high voltage work (multicore armored) or on transformer "tails" to switchgear (single core non-armored) which will require mechanical protection.

1.4.7.4 XLPE for 3.3 kV systems

XLPE/SWA/PVC - cross linked low density polyethylene insulated, stranded copper conductors, extruded PVC bedding, galvanized steel wire armored, flame retardant black PVC

sheathed overall, suitable for use on an earthed system at a rated voltage of 1.9/3.3kV as specified. Conductor temperature shall not exceed 90°C for continuous operation and 250 °C for short circuit. Cables shall comply with BS 5467.

1.4.7.5 XLPE single wire armored cable

XLPE/SWA/PVC cross-linked, low-density, polyethylene-insulated, stranded copper conductors extruded PVC bedding, galvanized steel wire armored, flame retardant black PVC sheathed overall, suitable for use on an earthed system at a rated voltage of 0.6/1kV as specified. Conductor temperature shall not exceed 90°C for continuous operation and 250 °C for short circuit. Cables shall comply with BS 5467.

Non-magnetic armour of hard drawn aluminum shall be used on single core cables.

1.4.7.6 PVC insulated single wire armored cable

PVC/SWA/PVC PVC insulated, extruded PVC bedding, galvanized steel wire armored, flame retardant black PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1 kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with BS 6346:1997 and sheathing with BS 7655-2.2:1993.

Non-magnetic armour of hard drawn aluminum shall be used on single core cables. The cables shall be used on the low voltage (415V) systems for cable ratings up to and including 10mm², or control systems as appropriate shall be:

multi-core, PVC insulated, extruded PVC bedded, single steel wire armored, PVC over sheathed, or single core, PVC insulated and sheathed, unarmored, or single core, PVC insulated, aluminum wire armored with overall black PVC sheath.

1.4.7.7 Polyethylene insulated armored instrument cable

Cables for use as instrument cables shall be to BS 6622 and shall be multi-pair, polyethylene insulated and bedded, single wire armored PVC over sheath.

1.4.7.8 Sheathed and insulated flexible cords

These cords shall be to BS 6500 and shall be 85o rubber insulated, H.O.F.R sheathed.

Flexible cords shall only be used for the following:

final connection between fused connection units, having flex outlets, junction boxes, and their associated appliance.

lighting pendants.

The minimum cross sectional area of conductors in flexible cords shall be 0.75mm² (24/0.2mm) and the length not exceeding 400mm.

1.4.7.9 Flexible power cables

Flexible cables where required and used to supply submersible motors shall be 600/1000 V grade EP rubber insulated with Niplas outer sheath having flexible, annealed and tinned copper conductors. Alternatively, standard manufacturers' cables may be considered, subject to approval of the details.

1.4.7.10 PVC insulated cable

This cable type shall be PVC insulated 600/1000 V grade copper cable to BS 6004 and shall only be used when enclosed within a conduit or trunking.

1.4.7.11 PVC insulated and sheathed cable

This cable type shall be PVC insulated PVC over sheathed 600/1000 V grade copper cable to BS 6004 and BS 6346 and shall be used as meter tails or transformer tails to switchgear provided that it is protected from mechanical damage. This type of cable shall also be used for direct surface run domestic wiring.

1.4.7.12 Screened cable

These cables shall be PVC insulated, lapped with a non-hygroscopic tape, and tinned copper wire braided. Signaling cables shall conform to BT Specification CW 1128 with armoring to CW 1198.

1.4.7.13 Bare copper earth wire (BCEW)

An earth wire shall be run with any selected cable, and be buried in the trench with it. The minimum size of earth wire shall be half the cross sectional area of the cable with which it is laid, and fixed to the power cable with nylon tie clips at regular intervals not exceeding 2,000mm. The earth wire shall consist of annealed bare stranded copper conductor.

1.4.7.14 Earth bonding cables

Earth bonding cables shall be PVC/PVC type and have stranded copper conductors PVC insulated and sheathed.

1.4.7.15 Cable installation

▪ General

The Contractor shall plan and position all cable runs so that they do not foul other services, maximum accessibility is maintained and unsightly crossovers are avoided. The cable routes shall be planned along with other services so that agreed service reserves are followed.

All cables shall be neatly run, dressed and supported to the approval of The Engineer.

All cable supports and racks together with fixing bolts, clamps, nuts and screws for indoor situations and in cable trenches shall be included, and shall be made from galvanized steel or cast silicon aluminum. Cable supports and racks shall be made by a recognized manufacturer and to the approval of The Engineer. All supports and racks shall be arranged for the easy removal of any single cable in a multi-cable run without threading cables through supports and racks.

The Contractor shall produce a cable schedule so that all information relating to the cables is maintained. This information includes dates of manufacture, dispatch, delivery to Site, installation, initial tests, connecting up and final testing and commissioning. In addition, the Contractor shall maintain a daily/weekly record of the cables as installation proceeds. These records shall be witnessed as necessary and shall form the basis of the record drawings.

Where cables are run together in the same tray, trench or conduit they shall be suitably derated or spaced to maintain current rating. Crossovers shall be avoided where possible. Power and signal cables shall be run separately to minimize interference.

Where a number of cables are terminated in plant, they should finally approach the plant from a common direction.

The Contractor shall supply all cable tray, cable trunking, saddles, cleats, hangers, brackets, trays, ladders, ties, nuts, bolts, screws, washers, packing and marker tape as may be necessary to complete the installation.

Marker tape shall be 150mm wide, yellow with black printing "DANGER-ELECTRIC CABLES".

Where cables cross other services or other cables the required separation shall be maintained. In addition, concrete cable tiles shall be provided between the services to maintain the separation and protection, the tiles extending for a distance of 1000mm either side of the existing services.

Power cables shall be installed without tees or joints unless approved by the Engineer. Cables shall not be installed in areas of direct sunlight. Where this is unavoidable, approved sunshields shall be supplied and installed.

All cables shall be suitably protected. Those running on the external surfaces of structures shall be protected against the effects of ultra-violet light. Where cables are sleeved through conduit or ducts, all ends shall be bushed to prevent damage to cable sheathing. The Contractor shall be deemed to have allowed for cable protection in his rates.

The as-installed drawings provided by the Contractor shall clearly show all services and cable details and dimensions.

▪ **Installation direct in the ground**

The Contractor shall carry out all excavation, supply and install pipes or ducts where required, prepare the trench bottom, lay cables, provide and install markers warning slabs and warning tape, backfill, consolidate, compact and make good, including the removal and disposal of all surplus material.

Power cables of rated voltage up to 1,000 V shall be buried at a minimum depth of 600mm to the cable. Power cables of rated voltage above 1,000 V up to and including 15kV shall be buried at a minimum depth of 1,000mm to the cable centre. This may only be varied due to the presence of other cables or services.

The bottom of excavated trenches shall be free of sharp stones and other obstacles and shall be covered with sand or fine sifted soil compacted to a depth of 75mm.

Cables shall be unrolled from the drums in such a manner as to avoid loops and kinks, and care shall be taken when laying to avoid damage to the outer sheath by drawing over sharp obstacles or stones. A sufficient number of rollers shall be provided so that the cable does not touch the ground or twist during pulling.

Cables shall be snaked into the trenches to avoid tension in the cables during backfilling or from subsequent settlement. After laying, cables shall be covered with a minimum depth of 100mm of sand or fine sifted soil. The cables shall be overlaid with marker tape, before backfilling the trench with soil.

Where cables of different voltages are laid together at the same depth, vertical cable tiles shall be used to separate the cables.

Controls and communication cables shall be laid not closer than 1,000mm to high voltage cables.

When cables are in position in the trenches, an inspection will normally be required by the Engineer before backfilling commences. 1st lay warning (Hatari) protective slabs above cable before backfilling. The first stage of backfilling is to be sifted soil or sand (as specified for the trench bottom) with cover being provided to a minimum of 70mm over the cable. Soft excavated material free of stones is then backfilled with the backfill rammed every 150mm.

Small stones extracted from the excavated material may be mixed in with the backfill in the final stages, but large stones are to be removed from site. Surface material and any hard core removed prior to excavation is to be backfilled last and well rammed to restore the undersurface to original condition. Excess backfill is to be removed from the site.

The Contractor is responsible for reinstating any damage to gates, hedges, kerb stones, concrete paving, etc, and normally for the surface of any privately owned made up roads. For public roads reinstatement of made up road surfaces will be carried out by the road

authority and the trench backfill must be left in a suitable condition as required by the road authority.

Approved surface route markers shall be situated at all joints, bends and at minimum intervals of thirty meters on straight runs, as specified. Whenever the cables change direction markers shall be so placed that the change in direction is readily seen.

No cables shall be buried direct in the ground within buildings or concrete covered areas.

▪ **Installation in underground ducts**

Where cables are laid under roads and paved areas more than 1,000mm wide, they shall be installed in continuous runs of approved underground ducting.

Underground ducts shall be constructed of impact-resistant uPVC and laid at a minimum depth of 600mm (to the duct centre), surrounded by at least 75mm of sieved sand. At road crossings, uPVC ducts of minimum diameter 100mm shall be laid at a minimum depth of 1,000mm (to the duct centre). The duct shall be encased by 150mm concrete on all sides.

When installing cables in ducts the following measures shall be observed:

- cables shall be pulled in a straight line.
- rollers shall be positioned at the edges of draw pits both at the drawing in and drawing out points over which the cables shall be drawn.
- uPVC pipes and cables sheaths shall be coated with an approved lubricant.
- sufficient draw-in points shall be provided and adequate room allowed for installation of cables.
- the pulling rope shall be guided by rollers.

In general, only one power cable shall be drawn into one duct. Where multiple cable systems are used, smaller cables (16mm² and below) may occupy the same duct.

However, details must be agreed with the Engineer, and included on the Contractor's working drawings.

When a duct is laid in the ground, a draw wire shall be pulled through with at least 1,000mm excess at each end and the draw wire left if the duct is not to be used immediately.

▪ **Sealing cable entries into buildings**

Where cables pass through walls below ground level, the point of entry shall be sealed against the ingress of water. This shall be achieved with "petroleum tap" and mastic or silicon foam.

Where cables pass in or out of any duct entries into or within buildings, such entries together with any spare ducts, shall be sealed against the ingress of moisture by means of duct stoppers and bituminous compounds or by any other method approved by the Engineer. The stopper shall have a fire resistance of at least thirty minutes.

▪ **Marking of underground cables**

The location of all direct buried underground cables shall be identified by:

- brass plates fixed to the exterior surface of all walls of buildings 300mm above ground level and directly above the point where cables pass through the wall;
- marker posts on road verges, etc., at intervals of not more than 100 m and at all junctions and changes of direction along the route;
- marker posts at ten meter intervals within an enclosed site and at all junctions and changes of direction along the route.

Marker posts shall be of concrete, not less than 150mm high above ground level with an inscribed brass or enamel metal plate. The inscription shall indicate the presence of a cable below, the depth and voltage rating.

▪ **Installation in cable trunking**

Cabling trunking shall be manufactured from heavy duty mild steel of thickness not less than 125mm and hot dipped galvanized. The Contractor shall ensure that the size of the trunking is adequate for the number of cables to be installed together with 50% spare capacity. Trunking shall have minimum dimensions of 50mm x 50mm.

Segregation of cables shall be carried out if required using continuous sheet steel barriers with the bottom edge welded to the trunking.

The trunking shall have two return flanges for rigidity. Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge. Fixing screws for covers shall be recessed and be of the self-retaining "quick fix" type. All bends, tees and intersections shall be of the gusset type and shall, wherever possible, be purpose made by the manufacturer and of a matching design to the main trunking.

Earth continuity straps shall be provided at all connections and jointing points along the route of the trunking to ensure complete earth continuity.

Cables shall be retained in the trunking when the cover is removed by means of straps. Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.

Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors. Conduit connections to trunking shall be made by flanged couplings and male bushes.

Trunking shall be supported at intervals as detailed in the IEE Wiring Regulations. Crossings over expansion joints shall be made in flexible conduit.

Should it be necessary to cut or drill a section of trunking or a trunking fitted the bared ends shall immediately be given a coat of zinc rich cold galvanizing paint.

Cable and trunking runs shall be determined by the Contractor and agreed by The Engineer before any work is started. The run shall be at least 150mm clear of plumbing and mechanical services.

Trunking systems erected outside a building shall be weatherproof.

▪ **Cable installation in conduit**

Conduits shall, in general, be galvanized heavy duty gauge steel screwed type for outdoor applications. Accessories shall either be malleable cast iron or pressed steel. PVC conduit will be considered for certain installations as specified. Conduits and fittings shall comply with BS EN 50086-1:1994, BS 4607 and BS EN 50086-2- 1:1996 as appropriate and shall not be less than 20mm diameter.

A space factor of 40% shall not be exceeded, and conduit of less than 20mm diameter will not be permitted. The tubing is to be perfectly smooth inside and out and free from imperfections. Both ends of every length of tubing shall be reamed with all sharp edges removed before erection.

Where conduits converge, adapter boxes shall be used. Conduits shall be connected by means of male brass bushes and couplings. Where conduits are greater than 25mm, straight through joint boxes shall be of the trough type.

Where conduit or fittings are attached to plant casings, the material of the casing shall be tapped for a depth of not less than 10mm or male bushes and flanged couplings may be used.

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Hexagonal lock nuts shall be used at running joints. They shall seat firmly and evenly on to mating faces. All junction boxes, draw-in boxes, and inspection fittings shall be placed so that the cables can be inspected, withdrawn and re-wired during the life of the installation.

Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits during erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators or appliance fittings.

Ends of conduits that are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress or dirt and covers shall be fitted on all boxes.

Generally, conduits shall not cross expansion joints of buildings. Where they cannot be installed in any other manner, a galvanized flexible conduit shall be used across the expansion joint. A total of 150mm movement shall be allowed.

Surface conduits shall be secured and fixed by means of distance spacing saddles or clips which allow the conduits to be taken directly into accessories without sets or bends. Conduits shall be run in a square and symmetrical manner. Runs shall be properly ventilated and allow for drainage of condensation. All surface conduit runs shall be marked out for approval by the Engineer before the installation is carried out. Where large multiple parallel conduit runs occur, galvanized trunking may be used instead.

Conduits installed on structural steelwork shall be secured by girder clips, drilled and tapped to the steelwork. Power driven fixings shall be used only with the approval of the Engineer. Any drilling or access that is required through any structural member of the building shall be clearly shown on the Contractor's Documents submitted to The Engineer for approval. The Engineer may either restrict the size and locations of approved drilling or access, or may instruct the Contractor where such drilling or access shall not be allowed.

Exposed threads and plates where galvanizing has been damaged shall be cleaned and then painted with two coats of an approved metallic zinc based paint. This treatment shall be applied as the work proceeds.

Concealed conduits shall be securely fixed to prevent movement before laying of screed, floating of plaster, casting of columns or other building operations necessary after the conduit installation.

Crampers or similar fixings shall be used for attaching the conduit to block work, etc. Building nails will not be accepted.

At least 15mm shall be allowed for finishes over the conduit. Where this cover cannot be maintained then expanded metal shall be fitted over the conduit. Conduit cast into reinforced concrete shall be fixed to shuttering to give a flush finish, and the conduit boxes shall be of a type approved by the Engineer for use in such locations.

Conduit installed in voids, false ceilings, and other concealed routes shall be installed as specified for surface conduits. Draw-in wires shall not be pulled into the conduits during erection. Wiring shall be carried out after the false ceiling or permanent ducts have been completed. Conduit installed in floors shall be sealed against ingress of moisture. The conduit installation shall be inspected by the Engineer before the building operation conceals the work.

Flexible conduits shall be of the waterproof galvanized type of PVC wire-wound type with cadmium plated mild steel couplings. Lengths of flexible conduit shall be sufficient to permit withdrawal, adjustment or movement of the plant to which it is attached and shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.

Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a trough type box. The flexible conduit shall extend from this box to the plant; the earth continuity cable shall be secured to the box and to the item of plant. The use of lid facing screws, etc. will not be permitted.

Adapters shall incorporate a grub screw or a gland to prevent the flexible conduit becoming loose.

In locations where galvanized conduit would be liable to corrosion, PVC conduit shall be considered.

PVC conduit shall be of the oval or round high impact non-flame propagating type as specified and self-extinguishing. Surface and concealed installations shall be generally as described for steel conduit.

PVC conduit fittings shall comply with BS 4607-1:1984. They shall all be white unless specified otherwise.

Jointing shall be carried out using PVC solvent and socketed accessories. Expansion couplers shall be fitted in straight surface runs every 12m. The free end shall be sealed with non-setting mastic to form a waterproof seal.

Purpose made bends may be used providing that the cable bending radius is maintained. Cracked or crinkled conduit will be rejected.

The conduit shall be suitable for use in ambient temperatures of between 10°C and 60°C and shall not be installed in areas that receive direct sunlight. A separate protective conductor (earth continuity conductor) shall be installed.

Adaptor boxes and accessories shall be made from heat resistant insulating material. The minimum wall thickness of boxes having a nominal internal depth of 16mm or less shall be 1.5mm. For deeper boxes the minimum wall thickness shall be 2mm. All boxes which are intended to support luminaries or other heat sources shall have either external fixing lugs riveted to the metal fixing inserts or utilize steel insert clips.

1.4.7.16 Cable terminations, joints and identification

▪ General

Cable terminations shall be provided to suit the requirements specified and shall be either crimp type lugs, crimp type insulated wiring pins or soldered connections.

Where crimp type terminations are used lugs shall only be applied using a crimping tool having a ratchet which only releases after the correct pressure has been applied.

Excessive solder and "dry" solder connectors will not be accepted. Care shall be taken to eliminate "dry" solder joints and in removal of excess solder.

Cable lugs shall be of such a size that only the minimum amount of solder is required in order to sweat the lugs solidly onto the tail ends.

The foregoing termination methods are not essential in "domestic" lighting and power installations beyond the final distribution board.

At terminations the cores of the cables shall be left of sufficient length beyond the termination to form cable tails for connecting to the plant. Tails shall be adequately insulated and each cable core shall have its phase identification clearly marked.

Terminations shall be long enough to allow one additional termination.

The installation requirements associated with both the low voltage and control cables are such that, in general, no joints are necessary, the cable distances being such that one complete cable length is required between the various items of Plant. Where joints are permitted, they shall be made as set out below.

- joints in cables shall be made in accordance with the cable manufacturer's recommendations to suit the particular cable type;
- all cables shall be joined color to color and shall be tested for insulation resistance and continuity before jointing commences;
- the seals of the cables shall not be removed until preparations for jointing are complete;

- joints shall be finished on the same day they are begun, and protection from weather shall be provided by the Contractor;
- cast resin molded type joints shall be used for PVC multicore cables;
- the jointing cores shall be insulated by means of several wrappings of PVC tape and then coated with PVC paste;
- the cable armoring shall be made continuous within the joint with copper bonding tape and clamps;
- a split mould, preferably of PVC, shall encase the joint and be filled with a proprietary brand of polyester resin.

▪ **Termination of screened signal cables**

Where the termination of a screened signal cable is required the cable shall be bonded to earth at one end only and the termination carried out as follows:

Screen to Earth Connection - A suitable length of overall sheath shall be removed, the conductors separated from the screen and the screen insulated using a PVC sheath self-colored green/yellow. A 30mm long silicone rubber over sleeve shall be installed over the point of separation of the conductors, screen and overall sheath.

Isolated Screen - A suitable length of the overall sheath and the screen shall be removed and a 30mm long silicone rubber over sleeve installed over the point of separation of conductors and overall sheath.

▪ **Cable glands - general**

Glands shall comply with BS EN 50262:1999. They shall seal the inner and outer cable sheaths against ingress of dirt and moisture and provide mechanical support. Where cable glands are exposed to the weather these shall be protected by heat shrink plastic tape or purpose molded sleeves covering the gland continuously from overall sheath to the gland neck.

Where the apparatus enclosure classification requires sealed cable gland entries, sealing shall be achieved by using threaded cable gland holes and polyfluorethylene (PTFE) tape.

Where terminations are to be effected for XLPE or PVC insulated cable, a compression type gland shall be used with means of securing armour wires within the body of the gland, and shall be of a size suitable for the cable used. The gland shall provide both armour moisture seal and outer sheath seal.

PVC gland shrouds shall be provided for all terminations.

Cable glands shall be both electrically and mechanically sound and shall be complete with backnuts and bonded earth tags.

BW type indoor glands shall have a minimum of exposed armoring between sheath and gland. Self-adhesive PVC tape shall be applied to exposed armoring and glands before the shrouds are fitted.

▪ **Identification of cores and wires**

Terminals shall be identified by using purpose made indelible markers.

Each core shall be identified, at points of termination, using color coded slip-on ring type markers.

The wire and associated terminal numbers shall be identical.

Where source and destination terminal blocks have different numbers, cores shall be double ferruled with both numbers.

Unless otherwise specified it shall not be necessary to identify terminations in domestic installations beyond the final distribution board.

▪ **Power cable terminations and joints**

Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors. Each cable entry into a terminal box shall be made through a suitable gland.

Boxes shall be of adequate proportions to accommodate all cable fittings including stress cones or other means of insulation grading. Boxes shall be openable for inspection without disturbing the gland plate, cable or termination.

Where air insulated terminations are used, the cable crutch shall be protected by a heat-shrink sleeve.

Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.

Glands for armored cables shall provide a positive armour clamp to the box or switchgear coating. This clamp shall completely support the cable weight so that no tension is applied to the termination. The clamp shall also provide earth continuity and be of adequate size to withstand the full fault current of the system for one second.

Where single core glands are required, these shall be non-magnetic. The gland plate shall also be of a non-magnetic material. Removable connections for bonding across the gland insulation shall be provided. The gland insulation shall withstand a test of 2 kV ac for one minute.

Aluminum cores of power cables shall be terminated using approved bimetallic connectors. All glands shall be provided with an earthing tag. For cables of 4mm² or less, a serrated washer may be used instead for earth continuity.

▪ **Multicore and control cable terminations**

A sufficient number of terminals shall be provided to terminate all cable cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.

Terminal blocks for terminating cables up to and including 35mm² shall securely clamp the conductor, without damage, between two plates by means of a captive screw; pinch screw type terminal blocks shall not be used.

For cables above 35mm², stud or bolted terminals shall be used, each cable being fitted with a suitable lug.

Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose made solid links shall be incorporated in the design of the terminal blocks.

Terminals that remain energized when the main plant is isolated shall be suitably screened and labeled.

Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labeled.

Plant that has to be dismantled for maintenance shall have multicore cable terminations made off through glands onto an adaptable box. The box shall have terminal blocks, and connections shall be made to the plant by single core wires and flexible, waterproof plastic conduit. A separate earth core shall link the box to the plant.

The Contractor shall supply and install complete approved marshalling boxes for both indoor and outdoor use, as required for terminating and marshalling all power and control cables at each item of Plant or en route as required. Spare pairs shall be included to facilitate cross-patching in the event of a fault developing on the operational pairs. All marshalling boxes and terminals within panels and mimic panels shall accommodate all control cable requirements. Details of which, shall be agreed and approved by the Engineer.

1.4.8 LV Switchgear and Control Gear

1.4.8.1 Introduction

This section of the Specifications covers all switchgear and control gear up to 1,000V AC, including distribution switch and fuse boards, multicolor control centers, control panels and desks, as well as individual units.

LV switchboards and panels shall comply fully with BS EN 60439, and be rated and ASTA certified for operation on a 415/240 V, -3 phase, 4 wire, 50 Hz supply. They shall have a minimum prospective short circuit fault rating of 5 kA. The fault ratings shall be commensurate with the fault levels of the network to which the components are connected. The Contractor shall be responsible for establishing the fault level at each site and designing the panels accordingly.

The Contractor shall be responsible for checking the panel and switchgear manufacturer's drawings, together with all necessary interfacing requirements with THE KENYA POWER AND LIGHTING COMPANY and others. He shall signify his approval in writing to the Engineer and submit copies of all manufacturers' drawings for the Engineer's approval. The Contractor shall be responsible for carrying out measurements of prospective short circuit current and earth fault loop impedance at each LV switchboard/distribution board upon completion of the works and shall incorporate the actual values onto the "as-installed" drawings.

1.4.8.2 Construction – general

Switchboards and control panels shall be flush fronted and accessed, manufactured from 2.0mm minimum thickness mild steel, multi-cubicle type. They shall be of folded and welded construction forming rigid units. Floor mounted panels shall be equipped with a mild steel channel bed frame at least 100mm high to ensure rigidity and shall be impervious to corrosion by rust. Small units may be of the wardrobe type.

The switchboards and control panels shall generally be of the industrial/enclosed modular cubicle type. The switchboards and panels shall be of the cubicle pattern suitable for floor or wall mounting, comprising a sheet steel cubicle with front access as required and specified complete with bus bars, circuit breakers, fuse switches and MCCB's. They shall be of uniform height, rigid construction and neat appearance.

Where rear access is possible, removable covers shall be provided for cabling etc. Separate cable compartments shall be provided.

All switches and breakers shall be individually labeled, showing the circuits controlled, by means of laminated plastic labels showing black letters on a white background.

Busbars shall be copper on insulated supports and capable of withstanding the fault level on the system at that point.

Switchgear shall be heavy duty, cast metal enclosed type, dustproof, and capable of operating on load at the rated current. Contacts shall be heavy duty silver surfaced type.

Cubicles shall be rigidly constructed. Those accommodating heavy duty switchgear shall be provided with an angle iron or heavy gauge folded steel framework, paneled in zinc anneal or galvanneal.

All mounting brackets and additional items shall be supplied and installed to suitably support the switchboard in the position in which it is to be erected.

Ventilation shall be provided where required, with fine bronze mesh and suitable trim fitted to prevent entry of insects.

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Dust tight enclosures shall have ample volume to dissipate heat that may be generated in service, and doors shall be provided with a neoprene seal fitted with a channel and closing against a suitable folded edge or ridge. Molded sealing strips may be submitted for approval as alternatives.

Switchboards and control panels shall consist of incoming fused switches, circuit breakers or isolators, and outgoing circuits controlled by fused switches, switch fuses, MCB's and MCCB's as required.

No live metal shall be exposed by the removal of normally closed or fixed doors or panels. Shrouds or insulated barrier pieces shall be provided.

The use of either circuit breakers or fused units is subject to final approval by the Engineer. Alternatives to the use of the circuit breakers indicated will be considered, but only as an alternative.

Entry of cables, ducts, and conduits shall be neatly made and head boxes shall be provided as required. All entries and openings shall be vermin-proof.

The maximum height of panels shall be 2,200mm above finished floor level.

Where switchboards are split for delivery each section shall have a maximum width of 2,000mm and a maximum mass of 1,000kg with removable eyebolts provided for lifting.

Unless otherwise specified, all contactors and relay control circuits shall be connected to an ac supply of a maximum of 240 V.

Isolation of a control circuit supply to one or a group of starters shall not interrupt supplies to other starters.

All fuses shall be of the HRC type to BS 88. Fuses rated 30 A and below shall be mounted in approved, withdrawable fuse carriers. Carriers containing links shall be colored white, whilst carriers containing fuses shall be colored black.

Timer delay relays shall have a good repeat accuracy and the direction of adjustment for increasing and decreasing the timing period shall be clearly marked.

The circuit breaker associated with each starter shall be a triple-pole unit rated for stalled motor duty and shall comply fully with the relevant British Standard. A padlocking facility shall be provided for locking in the OFF position.

The circuit breaker shall generally be housed within the same compartment as the starter with which it is associated and shall be mechanically interlocked with the compartment door.

The control supply shall be broken by auxiliary contacts on the circuit breaker in the open position.

The switchboards and panels shall be designed so that they can be extended in the future with the addition of further busbar/cubicle sections.

1.4.8.3 Mounting

Fixings for floor mounted switchboards and panels shall be by not less than four holding-down bolts at the front and rear of the plant. They shall not be visible from outside the panel, but be readily accessible from within.

At least four lugs shall be provided for bolting wall-mounted switchboards and panels to the wall. Fixings holes shall not be provided inside the panel, which shall stand at least 10mm off the wall surface.

Fixings for post/column switchboards and panels shall be provided outside the enclosure. The back of the enclosure shall be drilled to accept fixings.

All mounting brackets, supports and additional items shall be supplied and installed to securely support the switchboards, panels and cubicles in position.

1.4.8.4 Cubicles

Separate cubicles shall be provided for each of the following:

- incomer;
- bus-section;
- motor starters
- common controls;
- telemetry;
- distribution board;
- feeder;
- outgoing terminations;
- other specified plant;
- spare.

Each cubicle having its own door shall be totally separate from any other so that work can be safely carried out in one cubicle while others are still live.

1.4.8.5 Doors and covers

Doors shall be adequately sized to readily and neatly accommodate all plant to be mounted on them. They shall open at least 120°, be rigidly constructed, suitably braced and provided with at least two substantial hinges which shall be captive when the door is closed.

Lockable catches shall be used, each being provided with three keys on individual rings having a nameplate showing its identity details. Locking combinations requiring different keys shall be approved before manufacture.

Where padlocking facilities are specified, the padlocks will be supplied.

No plant shall be mounted on covers. Large covers equivalent to half full height and above shall be provided with handles to facilitate removal and replacement.

Each door and cover shall be provided with an internal welded earthing stud, and shall be bonded to the switchboard main earth bar.

Doors and covers giving access to potentially live conductors shall be provided with prominent warning labels.

Suitable shrouds or covers shall be provided for all live terminals and terminations, such that accidental contact cannot be made by the operators or maintenance staff.

Where required, provision shall be made for inter-locking the incoming THE KENYA POWER AND LIGHTING COMPANY supply and standby diesel supply such that paralleling cannot take place under any circumstances, where installed. The inter-locking shall be by an approved means, castelle keys being provided. All other switches or breakers shall be

provided with an approved means for locking off. Inter-locks shall be provided such that the front covers for any unit cannot be opened when the switch is in the "ON" position and the switch cannot be operated when the cover is in the open condition. Flexible earth continuity bonds shall be provided for all hinged and swing panels.

1.4.8.6 Component mounting

Each cubicle shall be provided with a removable rust-proofed steel backplate bolted to studs welded onto the rear of the cubicle. All components, other than door mounted, shall be located on the back plate by bolting into tapped holes or using self-tapping screws. Nuts used to fix components shall be captive on the back plate. DIN rail type fixing may be used where appropriate.

Components shall be so mounted to prevent shock being transmitted from large components and thereby adversely affecting their proper function. The components shall be arranged to give adequate accessibility for maintenance and for removal of any one component with the minimum disturbance to the wiring. Plug-in connectors shall be used where possible.

1.4.8.7 Cabling arrangement

Cabling shall enter panels through removable gland plates of not less than 3mm thick steel or brass (for single core cables) fitted at least 350mm above floor level, the final height being dependent on the cable sizes and bending radii. They shall be rust-proofed and provided with a welded and bonded earthing stud and adequately sized to accommodate present and known future cabling requirements. Access to both sides of each gland plate when it is in position shall be possible from within the plant. Cabling shall enter at the top and/or bottom of panels as appropriate, and have a suitable means of fixing.

Gland plates are not necessary on small individual starters where access shall be by "knock outs". Gland plates shall be removable for drilling.

1.4.8.8 Bolts, nuts, washers and screws

All bolts, nuts, screws and washers used for the construction of the switchboard shall be nickel or cadmium plated, except fixings on the face of the switchboard, which shall be stainless steel.

1.4.8.9 Protection and finish

The internal color shall be white and the protection of externally mounted components shall be no less than that of the panel on which they are mounted. External colors shall be grey unless otherwise specified or approved. Full color details to be submitted with the Tender.

Cases shall be rubbed down, undercoated with suitable primer and finished in not less than two coats of hard enamel, oven baked where practicable.

Outdoor cubicles shall be protected to IP65 (weatherproof), with a rear sloping weather canopy projecting over the front by at least 150mm. Door-mounted components shall be protected by a vandal resistant secondary glazed door so that all controls and indicators are clearly visible. Doors shall be locked and provided with stays.

Protection classification for all internal boards and panels shall be IP54 unless there is a specific requirement and the manufacturer considers that a particular compartment requires louvered ventilators. In such a case the classification shall be not less than IP31. Louvres shall be provided with fine mesh screens.

Externally mounted panels shall also be protected from the sun, a sun canopy being provided. The canopy shall overhang the panel by a minimum of 500mm on all sides and shall provide an air gap above the panel of at least 200mm. Proposals shall be submitted with the Tender.

1.4.9 Busbars and main connections

Each switchboard or control panel as may be required shall be equipped with a set of three phase and neutral air insulated busbars rated for a current of not less than the future connected load

Busbars, risers and droppers shall be ASTA certified and manufactured from solid copper fully complying with BS EN 60439, enclosed in a separate chamber and shall be continuous over each section of panel as assembled prior to shipping, with the facility for future extensions at both ends of the panel. Busbars shall not be drilled for outgoing connections, which shall be made with clamps.

The riser and dropper bars shall be of an approved solid insulation phase segregated type, and fault rated to the same level as the main busbars. Riser and dropper bars shall be fully insulated.

Busbars systems shall be capable of withstanding a minimum prospective short circuit fault corresponding to the let through energy of a protective MCCB of equal rating to the busbar rating and connected to a prospective symmetrical fault level of 5 kA r.m.s.

The busbars shall be housed in their own compartment running the length of the switchboard or panel and shall not be exposed when any of the access doors or plates (other than those provided for busbars access) of the panel are moved for maintenance or other work.

Auxiliary bus wiring between units shall be protected and accommodated in areas other than the main busbar chamber.

All busbars shall be air-insulated, with tinned and bolted connections, clearly painted in correct color of red, yellow, blue for the phases and black for the neutral.

It shall be possible, by removing covers, to readily gain access to all busbar, riser, and dropper joints in order to check tightness of nuts and bolts.

The framework and cable armoring clamps shall be efficiently bonded (with continuous copper strip) mechanically and electrically to the building and switchboard main earthing system. A high conductivity copper earth bar shall be bolted and efficiently bonded to the main frame to run the full length of each panel. This shall be color coded yellow/green. Flexible earth continuity conductors/bonds shall be provided for all hinged doors and swing panels

1.4.10 Balance

The entire installation shall be balanced to the satisfaction of the Engineer and the Contractor shall carry out such alterations to switchboard connections as may be required to balance the installation.

1.4.11 Circuit lists

The switchboards and distribution boards shall be fitted with a typed circuit list in the form of a card within a transparent envelope fixed to the inside door of each panel and distribution board. The form of the chart shall be to the approval of The Engineer and shall contain the following details:

- ☐ incoming cable type and size including any circuit protective conductor.
- ☐ size and type of incoming protective device.

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- measured values of earth fault loop impedance and prospective short circuit current at the board.
- size and type of protective device on all outgoing circuits.
- size and type of cables on all outgoing circuits including circuit protective conductors.
- block layout of switchboard components to assist maintenance staff in the identification, operation and function of each component.

1.4.12 Motor start

1.4.12.1 General

All starters and controllers shall comply in all respects to BS EN 60947, IEC 60947 or BS EN 60470:2001, IEC 60470:2000, and shall form complete individual package units or complete units within the switchboards.

The control and protection arrangements shall be suitable for the type, size, voltage and duty capability of the relevant motor and the Contractor shall state in detail the control and protection gear which he proposes to use for each type and size of motor.

The starters shall be of the triple-pole, air breaker type. Unless otherwise stated, for motors up to and including 3kW the starters shall be of the "Direct-on-Line" type capable of operating the relevant motor fifteen times per hour, suitable for remote automatic and local push button manual operation.

Unless otherwise stated, for motors over 3-10 kW the starters shall be of a current limiting type suitable for remote, automatic and local manual operation. For motors of over 20KW, they shall be soft start. The type of starter shall be selected with due regard to the nature of the load being driven to ensure that the starting current does not exceed 2.5 times the full load current. Current limiting starters shall be of the star-delta or electronic soft-start type. The number of starts per hour for each motor rating shall be stated, this generally being a minimum of five. Details are to be included in the supplementary information submitted with the tender.

In general, each motor starter shall be equipped with the following basic plant:

- door interlocked, fault make/ load break, on load, incoming main circuit breaker.
- contactors of the air break type fitted with arc chutes, magnetic blow outs and heavy hard drawn copper main contacts. Interlocks shall be provided to prevent simultaneous closure of the star and run contactors.
- timing relay, where required, shall be electromagnetically-operated controlled timing of contactor sequence; a fully adjustable eddy current retarding mechanism shall be provided where necessary to suit the nature and conditions of the motor.
- continuously rated operating coil (voltage to suit control conditions of 240V).
- auxiliary contacts for remote automatic control.
- adjustable over voltage relay unit.
- adjustable under voltage relay unit.
- overload relay device suitable for adjustment with calibration plates scaled in amperes. a door mounted reset facility shall be provided.
- control circuit fuses and links. *
- relay to protect against single phasing.
- ammeter of the moving iron type mounted on the starter and operated by a current transformer, where justified by rating, and complete with phase selector switch.
- provision for remote emergency stop button, float controls, etc.

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- ☐ hours run counter. *
- ☐ anti-condensation heater with thermostatic control.
- ☐ supply on, running and tripped indicator lights . *
- ☐ phase identification lights.
- ☐ test facility.
- ☐ hand/off/manual selector switches as required. *
- ☐ motor winding over-temperature release shall be provided in conjunction with the specified thermistor protection.
- ☐ duty selection switch as appropriate.*
- ☐ manual stop/start push-buttons *.
- ☐ relays to operate in conjunction with anti-vibration protection on larger motors shall be provided where specified.
- ☐ relays to operate in conjunction with bearing temperature thermocouples on larger vertical spindle motors are to be provided where specified.

* These facilities shall be door mounted.

Each starter shall be provided with a test facility enabling the control circuits to be energized only when the starter isolator and cubicle door are open. It shall not be possible to close the cubicle door with the test facility still switched on.

General layouts of the switchboards, control panels, etc. shall be submitted for approval before commencing manufacture. The final layout of all switchboards, panels, etc. shall be to suit the motor loads, standby diesel sets and mode of operation.

Suitable relays and timers shall be provided to prevent the simultaneous starting of the pumpsets unless the operating and protection systems are designed to accommodate the resulting starting surges.

1.4.12.2 Instruments, Indications and Alarm

The operating push buttons, switches or handles of all circuit breakers, motor starters, isolators, etc. shall be located on the front of cubicles, or for cubicles of the desk type, on the face of the desk. There shall be visual indications of the "ON" and "OFF" positions. The stop push-buttons (and remote emergency stop buttons) shall be operable at all times and for all modes of operation.

Lamps on the fascia of the switchboard shall clearly and individually indicate all operations of fault and alarm circuits. Fault and alarm lights shall remain on until the associated fault or alarm condition has been cleared and the system reset. An audible alarm shall also be provided to indicate operation of any major fault or alarm function. Acknowledgement of the major fault or alarm condition shall also cancel the audible alarm.

Indicating lamps shall incorporate a lamp test feature with either individual push to test or a common lamp test button.

Lamps on outdoor plant shall be shaded from sunlight so that their operation can be clearly seen at all times of the day.

Push buttons fitted on the panel shall be of the shrouded type, unless otherwise specified, and shall have a label indicating their function.

Indicating lamps on panels shall be rated to withstand not less than 20% continuous over voltage and shall be so designed that the heat from the bulb does not discolor the panel.

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Indicating lamps fitted into the fascias of switch and instrument cubicles or panels shall be adequately ventilated.

Lamps shall be easily replaceable from the front of the panel by manual means preferably without the use of extractors.

The bezel of metal or other approved material holding the lamp glass shall be of an approved finish and easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

The lamps shall be clear and fit into a standard form of lamp holder. The rated lamp voltage should be 10% in excess of the auxiliary supply voltage, whether AC or DC. For ac circuits lamp units shall be connected to the 110 V supply and shall have an integral transformer providing a 6 V supply to the lamp.

The lamp glasses shall comply with BS 1376 and BS EN 60073:2002 and are to be in standard colors, red, green, blue, white and amber. The color is to be in the glass and not an applied coating and the different colored glasses are not to be interchangeable. Transparent synthetic materials may be used instead of glass, provided such materials have fast colors and are completely suitable for use in tropical climates and remain unaffected by the lamp temperature.

To comply with BS EN 60073:2002, as a general principle, the following colors shall be adopted:

green -	supply available but switch, starter, etc., in the open position	white -
	switch or starter, etc., closed and plant running correctly	red -
	overload trips operated or major fault on plant	
amber -	warning signal, i.e. overloading of machine, high temperature,	
etc.		
blue -	as necessary for other indication	

Indicating lamps and push buttons shall be colored in accordance with BS EN 60073:2002 and in particular as follows:

<u>Indicating lamps</u>	<u>Color</u>
on	red
off	green
fault	yellow/amber
alarms	yellow/white
heaters	blue

<u>Push buttons</u>	<u>Color</u>
start	green
stop	red
alarm accept acknowledgement and mute	black
emergency stop	red

A separate indicator light or other means of indication shall be provided for each separate motor protection device to indicate activated.

Live line indication shall be provided at all panels so that the supply status in all sites, pumps stations or facilities is readily available to operators and maintenance staff.

Indicating light bezels manufactured from plastic will not be acceptable.

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All electrical indicating instruments shall comply with BS 89, EN 60051, IEC 60051, BS 3693 or equivalent approved standard, be of the moving iron spring controlled type self-contained instruments to Class 1.5 or better. Instrument size shall be 96mm square with quadrant scale.

All instruments shall be back-connected mechanisms well protected by strong cases that shall be earthed and fully insulated. They shall be clearly readable with black markings on a white background. A red pointer shall be provided, adjustable (with a tool) from the front of the instrument, to indicate the normal or maximum reading.

Instruments shall be of the industrial grade and shall have a means of zero adjustment from the front without the need for dismantling. They shall be capable of sustaining the normal full load current, voltage, (via current transformer or other transducer as necessary) and shall not be damaged by the effects of faults in the system being monitored. Scales shall be of the 270° type.

All wiring, space and connections and other items shall be provided for tariff meters, ammeters, voltmeters, selector switches and the like as applicable.

Instruments shall be flush mounted on the cubicles and effectively sealed against ingress of moisture, dust and insects. Instrument mounting height shall not exceed 1.80 m above floor level. Unless otherwise specified instrument full-scale deflection shall be at least 120% of the normal operating point (i.e. nominal voltage or full load current).

All relay cases shall be black glass finish.

All voltage circuits of instruments shall be protected by a fuse in each unearthed phase, situated as close as practicable to the point of connection.

Voltage selector switches shall give phase to phase, phase to neutral readings. The class of accuracy of all meters, voltage transformers and current transformers shall be provided with the Tender.

Voltmeters shall be suitable for operating from the secondary side of the 110 V voltage transformers.

Ammeters in motor circuits shall be capable of withstanding the starting current of the motors and shall have a compressed overload scale for this purpose. The full load current shall be defined with a red line. Voltmeter scales shall have a red line indicating normal voltage.

Current transformers shall have short circuit ratings not less than those of the circuits with which they are concerned, and shall fully comply with BS EN 60044-1:1999, IEC 60044-1:1996.

Separate current transformers shall be provided for protection and instrumentation duties. The rated burden of all current transformers shall be a minimum of 150% of the sum of the burdens to be imposed.

All current operated instruments and relays shall be suitable for operating on 5 A secondary windings of current transformers.

All protective relays, where provided, shall be fitted with indicating flags.

Instruments and relays shall be removed from the switchboards for transport and delivery and shall be packed in cases and transported and delivered with the associated switchboard.

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Where specified, capacitors for correcting power factor shall be incorporated in the panel. Such capacitors shall comply fully with BS EN 60831-1:1998, IEC 60831- 1:1996 or BS EN 60871-1:1998, IEC 60871-1:1997 as appropriate.

All motors shall be provided with emergency stop push buttons mounted on or adjacent to the motors that shall lock out the control circuit and shall require a key to reset the circuit.

1.4.12.3 Control Panel Cabling

Control wiring for motor control panels, switchgear, etc. shall be 600V grade PVC or XLPE insulated multi-stranded copper wire to BS 6004 or BS 6007. The minimum size shall be 1.5 mm² stranded conductors.

All terminals shall be referenced and detailed on the schematic diagrams to be submitted to the Engineer.

It shall be possible to gain access to any terminal of any component so as to be able to remove and replace the wire from that terminal without recourse to special tools, and without the need to disturb other components.

All wiring shall be neatly run bunched in neat forms. All wiring accessories of plastic material, such as cleats, conduits, strapping, etc., shall be non-corrodible and resistant to flame propagation.

Crimped pin extensions shall be fitted to all control circuit cables to prevent wandering strands before being inserted into Klippon type terminal blocks.

Cabling shall enter the panel from above or below as applicable and as specified elsewhere in the Specifications. Cables shall be terminated using external boxes or internal gland plates.

Where necessary cable tray work shall be provided for supporting and fixing cables, and full glanding and termination facilities shall be provided. Gland plates shall be mounted not less than 150mm above the cubicle bottom. It shall be possible to terminate all cables without requiring access to live interiors.

Primary cabling shall be completely isolated from all control wiring, etc., and auxiliary terminals shall be likewise isolated from primary terminals.

All terminal boards and terminal blocks shall be of a type providing a positive mechanical clamp on connection. Terminals for the connection of all external cabling shall be situated near their respective gland plate and at a minimum distance of 200mm from it.

Separate terminals shall be provided for incoming and outgoing connections and not more than two wires shall be connected to any one terminal.

Supplies for the motor heaters shall be controlled automatically by the main contactor such that the heater is on when the motor is de-energized. Motor heaters shall be separately fused and provided with termination facilities. Details shall be provided for approval.

1.4.13 Switchboard Construction

1.4.13.1 General

This section shall apply to the construction of all panels housing electrical apparatus, including but not limited to the following:

- Switchboards

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- Motor control centres
- Circuit breakers
- Control panels
- Monitoring or supervising panels
- Distribution boards – control panels
- Marshalling panels
- Interface panels
- Local control panels

1.4.13.2 Safety

Access to any enclosure of compartment shall be possible only;

When the circuit switch-disconnector is open and connections within the compartment are isolated or;

- When connections within the compartmental including any on the door or access cover, are fully shrouded to prevent accidental contact or;
- When connections within the compartment operate at a voltage not greater than 55 volts.
- Where a test facility is provided for use with the door or cover open the provisions of (b) shall apply. Connections which may be live with the door or cover open shall be suitably labelled.
- Bolted covers on compartments incorporating live connections shall bear a suitable warning label.
- Labelled isolators, fuses or links shall be provided so that relays, controls and instruments may be isolated but keep other essential circuits energised.

1.4.13.3 General Construction Standard

- The switchboard and all components shall be constructed to withstand fault currents as specified or required under the relevant standards and regulations.
- Switchboards, cubicles and enclosures for electrical equipment shall be constructed in sheet steel not less than 2.0 mm thick and suitably braced to form a rigid structure. Exterior edges and corners shall be rounded and the use of externally visible assembly bolts or similar shall be avoided.

The design shall provide protection against dust, damp and entry of vermin. Gaskets shall be fitted to doors and removable panels. Ventilation and cooling shall be by natural air circulation under the ambient conditions specified or to be expected. Unless specified otherwise, switchboards, cubicles and enclosures shall be floor-standing with lockable-hinged front doors and bolted removable rear panels for access to live equipment such as bus bars and terminals.

The switchboard shall fit in the space as stated or indicated on the drawings. If there is any reason will not fit into the space, the attention of the Engineer shall be drawn in good time to enable alternate arrangements to be made either to the board or to its fixing position. It shall be the responsibility of the electrical contractor to verify the suitability of the space provided before commencement of installation.

Each section shall be separately accessible without disturbance to other sections for maintenance and inspection. Live parts with voltages greater than 55 V to earth within the section shall either be isolated automatically when the section door is opened or be

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fitted with insulating barriers to prevent accidental contact by personnel. Parts still live when the unit is isolated shall be labelled "Danger Live".

Where integral fuse or MCB distribution boards are incorporated, access to fuse carriers and MCB's shall be possible without isolating the fuse or MCB distribution board. With the operator's door open and with fuses and MCB's in place, the degree of protection of such distribution boards shall be not less than IP20.

A clear access of not less than 1000 mm, and preferably 1500 mm, shall be given at the rear and both ends of the panel.

Controls and switches mounted on any control panel section of a switchboard shall be installed in the height range 750 mm to 2000 mm; indicating instruments 900 mm to 1800 mm; recorders 900 mm to 1400 mm. This requirement shall not be applied to starters or feeder sections.

Switchboards shall be equipped with a power transformer and 2 No. 15 A, 110 Vac (± 55 V) RCCB protected sockets, suitable for use with electric hand tools. Switchboards shall additionally have 2 No. 13 A, 240 Vac RCCB protected sockets. Each section of cubicle of the board shall be clearly labelled with circuit name and number, and the reference number of the section. The panel shall have a nameplate carrying the manufacturer's name, address, reference and year of construction of the panel.

Cubicles and enclosures shall be earthed. Where a number of cubicles are bolted together, earthing shall be provided via a continuous high conductivity copper bar of minimum cross section 25 mm x 6 mm running the length of the panel. Terminals shall be provided for the connection of earthing from the metal cladding or armouring of incoming and outgoing cables. Holes shall be left at each end of the bar for connection to the main station earth and future extension. The bar shall be fault rated at not less than that of the associated equipment. Warning labels and instructions for earthing and isolating shall be fitted in each switch compartment. Front access doors shall open not less than 120° and shall be fitted with a locking handle and non-ferrous lift-off hinges which shall be captive when the door is closed. Locking combinations requiring different keys shall be approved before manufacture. The door shall be secured by captive screws or locking handles of sufficient number to ensure firm pressure on the door seal around the whole periphery. The door shall be mechanically prevented from opening before isolation of the live parts within. All doors shall be separately earthed to the main frame. Earthing via the door hinge will not be accepted.

Cables shall enter through 3 mm thick undrilled removable steel or brass (for single core cables) gland plates mounted at least 250 mm above switchboard base level. Access to both sides of gland plates for gland tightening shall be readily available. Gland plate knockouts will only be accepted for individually mounted starters and small power distribution boards. Lifting eyeholes shall be provided at each top corner at each section of the switchboard and shall be removed and replaced with blanking bolts after installation. Cubicles and enclosures for outdoor locations shall be fitted with lockable outside doors and a housing so designed that all controls, instruments and such like are fully enclosed and the whole assembly is weatherproof and vandal proof. The doors shall be fitted with stays to prevent overstraining of the hinge fixing and allow fixing of the doors in the open position. Switchboards inside cubicles shall also be weatherproof to allow operation of the controls when the outside cubicle doors are open during inclement weather.

When specified, a double skin roof shall be fitted over the whole assembly to give added protection against direct sunlight.

LV enclosures shall be constructed to comply with SSRN 038 and have IP ratings of at least the following: – for outdoor installation IP 65, – for indoor installation IP 54. Switchboard, cubicle and enclosure construction shall be capable of withstanding without damage the

fault current of the system. HV enclosures shall be constructed to standards under SSRN 061 with IP ratings equal to those for LV enclosures. Protective coatings shall be applied at the place of manufacture and before installation of its internal electrical fittings.

1.4.13.4 Switchboard Small Wiring

Switchboard wiring shall be carried out in 600/1000 V PVC insulated cable to comply with SSRN 041. The conductors shall be stranded or flexible (where applicable):

solid cores will not be accepted. The conductor size shall be not less than 1.5 mm² for control and indication circuits and not less than 2.5 mm² for CT secondary circuits.

Wiring within the switchboard shall be marked with ferrules at each end for identification. The letters and numbers used shall correspond with the switchboard wiring diagram.

The wiring colour code shall be as follows: Phases -

red, yellow, blue

- Neutral -black
- Control -grey/black
- Earth -green/yellow

The wiring shall be neatly laced and cleated to the switchboard structure or contained within purpose designed plastic trunking and arranged so that access to equipment is not impeded. Where trunking is used the ratio of effective cross sectional area of the cables shall be not greater than 40% of the trunking area. Where wiring passes through metalwork the access hole shall be fitted with a suitable grommet.

Every wire shall be identified by indelibly marked circular ferrules at each end. Slip- on, 'u' type ferrules will not be accepted. Identification shall correspond with the wiring diagram. Wiring between cubicles or panel sections shall be terminated on terminal blocks at each end. Wiring onto hinged doors or plates which is subject to movement shall be run in flexible circular section trunking and shall be supported securely at both ends of the moving section. Adhesive fixings of the ends of the trunking will not be accepted. Crimped flat blades shall be applied to all wire ends to ensure sound connection to terminal blocks and all circuit components.

Small wiring used for control, extra low voltage and instrument signals which are likely to be affected by interference shall be screened and/or spaced from each other and power cables to ensure no distortion or mal-operation.

1.4.13.5 Switchboards Busbars and Primary Connections

All busbars and primary connections shall be of high conductivity copper to comply with SSRN 020 and SSRN 069. The mechanical and dielectric strengths of busbars and connection supports shall be able to withstand without damage the worst conditions of electrical surge which can occur on the installation. The busbars shall be capable of carrying full rated current continuously without exceeding temperature rise limits indicated in the above SSRNs.

The busbars, assemblies and connections of equipment shall be of a type which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short-time maximum temperature of the busbars and shall have such thickness as is required to withstand rated line to line voltage between busbar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

Where independent certification of busbar withstand and continuous rating is not available the Contractor shall include tests to demonstrate the suitability of the equipment.

Busbars and primary connections shall be housed in an air-insulated enclosure

segregated by barriers. Direct access to live bars shall not be possible. Access to busbars and connections shall be only by removal of bolted covers. Suitable warning labels shall be provided externally on covers and internally on shutters. Busbars shall be identified by coloured bands opened at not more than 1,000 mm and in each compartment.

Baffles shall be provided to prevent the accidental entry of tools, etc. whilst maintenance work is being carried out in the vicinity of the chambers.

Busbar systems shall have a short time rating not less than that of the associated switchgear. Busbars shall be extensive at both ends.

The conductors shall be separated and supported with the appropriate clearances in air or shall be otherwise adequately insulated or encapsulated.

1.4.14 Connections to Motors

1.4.14.1 General

The Electrical Contractor shall:

- a) Supply angle iron framework and channels as required.
- b) Erect starters on angle iron framework at motors, on walls, motor control centers or floor channels as indicated on the drawings.
- c) Provide wiring from the main LV switchboard to all sub-distribution boards, motor control centers, switches, socket outlets, junction boxes, motor starters and actuating devices.
- d) Ascertain exact locations of motor starters, motor control centers and control devices prior to installing and wiring up.
- e) Provide all control and interlock-field wiring.
- f) Provide isolators, lockout pushbuttons, etc. as noted.
- g) All the equipment shall be suitable for working at the rated voltage.

1.4.14.2 Installation: Connection to Motors

The Electrical Contractor shall supply and install PVC insulated conductors in heavy gauge conduit or PVC, SWA & PVC, XLPE and Tough Rubber Sheath cables as specified on perforated cable trays, with claw type cleats, in ducts and trenches, or MIMS cable as specified.

Final connections to motors shall be made as follows:

- a) Flexible conduit soldered or brazed into brass glands shall be used with an earth wire run through the conduit between the distribution board and the motor terminal box. Where motors are exposed to the weather or are mounted in moist environments e.g. sump pumps, the flexible conduit shall be of weatherproof quality and PVC taped overall, including the glands.
- b) Mineral insulated copper sheathed, PVC or aluminum sheathed cable installations shall terminate at the entry to the terminal box with a loop of cable, to enable the motor to be removed without damage to the cable, and also to eliminate cable fractures resulting from motor vibration.
- c) Where terminal box entries are restricted the conduit may be terminated with a conduit box and the final connection to the motor made by using flexible cable. In these cases, one extra core shall be provided in the flexible cable for earthing purposes.
- d) All motors more than two meters from a distribution board shall be fitted with an isolating switch of the correctly rated capacity, adjacent to the motor,

supplied and installed by the Electrical Contractor. When this is exposed to the weather the isolator shall be weatherproof. In the case of interlocked systems i.e. air conditioning; the isolator shall be lockable to prevent unauthorized switching.

e) Earth wires shall be run in conduit feeding motors, and control gear.

1.4.14.3 Motor Disconnecting Devices

Motor disconnecting devices shall be installed at motor locations where indicated and as required by the "standard regulations". Devices shall not be grouped at central location, except as indicated.

Disconnecting devices shall be provided either by means of a lock-out push button to interrupt the motor control circuit or by means of an isolating switch of ampere rating as noted on the drawings.

The Electrical Contractor shall allow sufficient clearance for removal of the motor(s)

1.4.14.4 Earthing: Connection to Motors

All non-current carrying metal parts of the equipment shall be effectively earthed.

1.4.14.5 Tests: Connection to Motors

All the power factor correction equipment shall be set correctly by the Electrical Contractor to the approval of the Engineer before any circuit is energized and tests carried out. The Electrical Contractor shall provide all the material and instruments required for testing and bear all the expenses incurred.

1.4.15 Overload relays

Overload relays shall be of the thermal type, with inherent ambient temperature compensation and single phasing protection. They shall be of the manual reset type, having mechanical indication of the tripped conditions, resettable without opening the compartment door.

Calibration shall be adjustable between 80 and 150% of the motor's full load current. On motor drives, of 100 kW and above, overcurrent relays shall be of the definite minimum and inverse time limit pattern.

1.4.16 Voltage protection relays

Regulation at certain towns has proven to be a source of plant failure and damage. Adjustable protection relays suitable for providing both under voltage and over voltage protection shall be included within the starter units. Full details shall be submitted with the Tender. The relay units shall be suitable for voltages of +10% and -15% of the nominal voltage.

1.4.17 Phase failure relays

Phase failure relays shall be connected to all phases and neutral and shall de-energize at or below 90% of rated voltage on any one or more phases. The relays shall be separately fused with contacts wired down to outgoing terminals.

1.4.18 Push buttons

Push-buttons shall be at least 25mm in diameter with chromium plated or similar Bezels. Plastic Bezels will not be acceptable.

They shall generally match indicating lamps in style, start push buttons being recessed to prevent accidental operation. Stop push buttons shall not be recessed.

Emergency stop push buttons shall be of the "stayput" mushroom-headed type. Composite motor control panels shall include a door mounted emergency stop button that will automatically shut down all pumping plant when activated.

1.4.19 Relay units

Relays shall be either of the plugs in or block type.

Plug-in relays shall be fitted with transparent plastic dustproof covers, retaining clips a base into which the relay plugs and external connections, made using easily accessible screw clamp terminals. Bases and relays shall be keyed to prevent relays being plugged into incorrect bases.

Block type relays shall be totally encapsulated.

Relays shall have changeover contacts and a means of visually indicating that they are energized.

The pin configuration of each relay shall be printed on the casing and on the schematic diagrams.

Time delay relays shall be of the multi-pin plug-in type and adjustment for increasing and decreasing the timing period shall be clearly marked.

1.4.20 Residual current devices (RCD's)

Residual current devices shall be back connected (behind the door), current operated, with a sensitivity of 30mA, door mounted so that the test push-button and operating lever are readily accessible.

Operation of RCD's shall not be impaired by any dc component in the current.

1.4.21 Selector switches

Selector switches shall be of the rotary type spring loaded to ensure clean controlled operation having bezels at least 50mm square with all switch positions fully and clearly identified.

They shall be equipped with sufficient contacts of the correct rating and type, if necessary by means of auxiliary relays, to enable all control/indication/alarm requirements to be fulfilled.

Operating handles shall be interchangeable and securely fixed to the switch mechanism by a keyed shaft and recessed retaining screws.

Where lockable switches are provided it shall be possible to operate them without the key, but also possible to lock them in any position and withdraw the key.

1.4.22 Switchboard and cubicle wiring

Ample wiring space shall be provided within the switchboards and cubicles and all wiring shall be carried out in a neat and systematic manner with cable supported clear of the panels and other surfaces at all points to obtain free circulation of air.

In all cases, the sequence of the wiring terminals is to be such that the junction between multi-core cables and the terminals is effected without crossover. Insulated bushes are to be provided where necessary to prevent the chafing of wiring.

All panel wiring is to comply with the requirements of BS 6231:1998 Type A or B, as appropriate. Conductors are to be copper and have a minimum cross section equivalent to 7/0.67mm (2.5mm²) or 1/1.78mm (2.5mm²), but single stranded conductors should only be employed for rigid connections that are not subject to movement or vibration during shipment, operation or maintenance. Flexible conductor's equivalent to 30/0.25mm (1.5mm²) or smaller sizes generally shall only be employed with the written approval of the Engineer.

No wires may be teed or jointed between points.

Electrical wiring and instruments are to be located so that leakage of oil or water cannot affect them.

Bus wiring between control panels, etc., is to be fully insulated and to be completely segregated from the main panel wiring.

All metallic cases of instruments, control switches, relays, etc., mounted on control panels or in cubicles, steel or otherwise, are to be connected by means of copper conductors of not less than 2.5mm² section to the nearest earth bar. These conductors may be bare or have insulation colored green or green/yellow striped.

Color coding of the separate phases, neutral and earth, shall be provided and maintained throughout the installation. Where necessary, further identification of wiring shall be provided to the extent necessary to permit any conductor to be located and traced. Also color coding of remote control and local control wiring shall be provided. Voltages of control systems shall be clearly stated.

Color coding shall be:

red	-	red phase
yellow	-	yellow phase
blue	-	blue phase
black	-	neutral
green/yellow	-	earth

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grey	-	110 V AC
white	-	Control circuits

Cable for specialist applications such as co-axial shall be of an approved type.

All wiring shall have crimped terminations, only one wire being held by any one crimp. Crimped lugs shall be of the insulated type without conductor exposure between the crimps and wire insulation.

The type of crimp used shall be appropriate for the type of terminals to which it connects.

Terminations shall be neatly arranged leaving adequate length for one additional termination.

Wiring shall be neatly laid in limit compression insulated cleats, insulated straps or, where more than ten wires follow the same route, in plastic slotted-sided trunking with clip-on cover. Where trunking is used, the ratio of effective overall cross-sectional area of cables shall not be greater than 40% of the trunking cross sectional area.

Holes in steelwork, etc., through which cables pass shall be protected using nylon grommets, or edging strip suitable for the size of hole.

Cables used for control, extra low voltage and instrument signal transmission likely to be affected by interference shall be screened and/or spaced from each other and from heavy current power cables, at a distance to ensure that resultant electrical "noise" is insufficient to cause any form of malfunction of associated plant.

All wiring shall be identified at each end by means of glossy plastic ferrules showing the wire number as on the schematic diagrams. Ferrules shall be color coded, "Z" type and indelibly marked.

1.4.23 Electric motors

1.4.23.1 General

All motors shall be of a make approved by the Engineer and shall be suitable for operating from the specified power supply. Motors shall comply in all respects with the relevant parts of BS 4999, BS EN 60034, BS 5000 and BS EN 50347:2001 and shall be designed to run at high power factor and efficiency at the prescribed plant duty.

Motors shall be three-phase, squirrel-cage, induction type, continuously rated for the heaviest specified duty, totally enclosed and suitable for operation on the electricity supply and determined by the Contractor in relation to the power requirements, ambient temperature, altitude and normal working conditions of the mechanical plant offered.

The starting (locked rotor) current of any motor shall not exceed 6 times the full load operating current. Motor starting torque shall be at least 120% of the pump torque requirements

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throughout the starting sequence. Motors shall be capable of running backwards at rated speeds under backflow conditions without damage to the motor.

In addition to the requirements of BS 5000, the motors shall be capable of satisfactory operation with a frequency variation of $\pm 1\%$ above or below the normal frequency of 50 Hz.

The design of the motors shall be adequate in all respects for the number of starts per hour required when the pumping plant is in normal operation.

Where an insulation Class is specified the requirements of BS 4999 and BS EN 60034 shall be met. The limit of temperature rise shall be for the appropriate Class of insulation quoted. Class G insulation shall be provided, but with Class B temperature rise limitations.

Motors shall be fitted with locating type bearings and/or heavy type thrust bearings at the non-drive end and roller type bearings at the drive and according to the type of motor offered. All bearings shall be of adequate proportions and design suitable for the particular application, and shall have ample capacity to allow the pump to operate for short periods with the discharge valve closed.

Details of the bearing types being proposed, grease, oil, shall be submitted for all vertical motors together with details of the grease lubricated bearings for horizontal split case motors.

The motors shall be built of high grade components and materials in accordance with the best practice for the type of plant offered.

Motors of 5 kW and above shall be fitted with temperature sensitive thermistors embedded in the motor to control a winding over-temperature relay mounted in the control cubicle. Each motor shall have at least three thermistors. The thermistors shall be suitable for connection to a monitoring unit in the motor control circuit to provide protection against winding failing due to overheating. The motor starters shall trip in the event of high winding temperature being experienced.

The motors shall be capable of delivering 10% more than the maximum power absorbed by the plant being driven. The motors, where practicable, are to be selected to provide an element of commonality and thus flexibility in use at each site.

Only ISO standard roller and/or ball grease lubricated bearings shall be fitted.

The grease lubrication shall be applied using hydraulic type nipples that are freely accessible, without any dismantling, or otherwise piped out to a readily accessible location.

"Sealed-for-life" bearings shall not be used.

Continuously rated anti-condensation heaters shall be installed in all motors above 5 kW that are to be installed in damp or cold environments. They shall be sized by the Contractor to suit the motor frame size.

Heaters shall be located within the motor so that the heat dissipated does not damage the insulation of any of the windings or associated cables.

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Terminal boxes shall be separated from the frame and shall be reversible to allow cable entry at the top, bottom or either side, suitable for cable glands required. Terminal mountings shall be arranged such that the motor supply wiring can be disconnected without disturbing its internal connections.

The end of each winding shall be brought out to a separate terminal, connecting links being provided to facilitate interconnection of individual terminals.

A diagram of connections shall be fixed inside the terminal box cover, which shall be provided with watertight, oil resisting gaskets.

Where motor anti-condensation heaters are fitted additional terminals and a separate cable gland entry shall be provided. A warning label on the terminal box cover shall be provided stating "WARNING, LIVE HEATER TERMINALS, and ISOLATE BEFORE REMOVING COVER".

Plates shall be fixed on each motor, giving the following information:

BS (or IEC) No _____	No. of Phases _____
Manufacturer _____	Motor kW _____
Serial No _____	Voltage _____
Insulation Class _____	Current at FL _____
Frequency _____	Speed _____

All motors rated at more than 160 kW shall be fitted with suitable vibration control devices to automatically shut down the motor in the event of excessive vibration. The Contractor shall stipulate the vibration tolerances associated with each motor rating above 160 kW and shall recommend appropriate control devices, details of which shall be submitted for approval.

For motors larger than 160 kW, kilowatt-hour meters, with maximum demand indicators shall be provided.

Vertical spindle motor units rated in excess of 5 kW shall be fitted with a thermocouple at the upper thrust bearing to shut down the motor in the event of the bearing temperature exceeding a recommended value. Details shall be provided for approval

Motors that are water cooled shall include suitable protection to safeguard against the lack of water flow.

Where required by the specified operational system, motor circuits shall include suitably rated rotary off, manual or automatic switches.

The Contractor shall submit details of the painting standards and color range being proposed. The Employer will finally decide on the color, this being in accordance with the manufacturer's standard color charts.

All motors shall be provided with two earthing terminals.

The motors shall be commercially silent in operation and shall run free from vibration. They shall be of robust design with frames and covers constructed in cast iron. Fan covers and cowls shall be of a strong and durable material (plastic, PVC or GRP will not be acceptable). The rotors shall be fully keyed to the shafts and shall be balanced both statically and dynamically.

Motors shall be labeled to correspond to their respective starters. These shall be at least 40mm x 75mm x 2mm in stainless steel on non-ferrous metal. Details shall be agreed.

Air vents and other openings where provided will be screen protected.

1.4.23.2 Submersible motors

Submersible motors shall be capable of continuous operation under water at the conditions specified. Heater requirements do not apply to these units.

The motor shall be installed vertically and rigidly coupled to the submersible pump such that both the pump and motor are completely flooded. The windings of the motor shall be insulated with an approved waterproof plastic or other approved material as recommended by the manufacturer. The motor shall be squirrel cage rotor motor with the rotor suitably supported in lubricated plain bearings.

The cable from the motor shall be sealed at its exit by a water tight cable gland. Sufficient cable shall be provided to meet the installation requirements.

1.4.23.3 Cables for submersible motors

Cables for submersible motors shall be a 600/1000 V grade multicore cable and consist of conductors of high conductivity tinned copper wire, EPR insulated and with super tough rubber sheath. The cable shall be suitable for suspension within a borehole approximately 60 meters deep and shall include all necessary internal supports (i.e. steel core or similar) to prevent

undue strain being imposed on the cable conductors. Two clips shall be supplied for each length of riser.

Details of the cable proposed shall be provided with the tender.

1.4.23.4 Emergency stop/lock-off push buttons

Emergency stop/lock-off push buttons shall be provided adjacent to the pumping units specified. Each shall be of the surface mounted weatherproof push to break and mushroom type with latching device to resist the push button return movement so that contacts remain normally open until the latch is released by a counter clockwise direction.

The buttons shall be robust and watertight suitable for the environment at the various locations, with IP enclosure. Certain stop buttons will be wall-mounted, others will be mounted on frames 1,000mm above the floor level, as stated in the Particular Specifications. The frames, boxes, terminations, screws and fixings shall be supplied.

1.4.24 Safety devices and controls

The control requirements for the pumping plant have generally been specified elsewhere. The Contractor shall include for all requirements to meet both the manual and automatic control of the plant and pumpsets. In addition to the safety devices already specified, the Contractor shall provide for other protection devices that are necessary to protect against any operating conditions which would be liable to cause damage to the plant, for example, lack of water at the pump suction.

1.4.25 Variable-speed drives

1.4.25.1 General

The variable-speed drives shall be purposely designed and manufactured for pumping applications. The variable-speed drives shall be suitable for all loads with variable torque characteristics.

The variable-speed drives shall be capable of starting and running high inertia loads such as centrifugal pumps.

The variable-speed drive supplier shall carry a comprehensive range of spares, which shall continue to be available for at least 5 years after the production of the particular variable-speed drive model has been discontinued.

The variable-speed drives shall be compatible for use with the various asynchronous squirrel cage induction motors typically used to power pumping plant.

The variable-speed drives shall be of sufficient capacity and shall produce a quality low distortion output waveform so as to achieve full rated nameplate shaft power output of the motor. The variable-speed drives shall be capable of operating any standard squirrel cage induction motor of the specified variable-speed drive's power rating without any modifications to the motor or the variable-speed drive.

1.4.25.2 Design

The variable-speed drives shall be fully digitally controlled.

The variable-speed drives shall consist of the following major components:

- full-wave bridge 6 pulse rectifier;
- DC link capacitors;

- Inverter stage with Insulated Gate Bipolar Transistor (IGBT) or Integrated Gate Commutated Thyristor (IGCT) power modules across the entire range (GTO or BJT devices shall not be acceptable);
- Control and display panel.

The variable-speed drives shall have high efficiency and have low maintenance requirements. The variable-speed drives shall provide an adjustable output frequency and voltage utilizing the principles of Pulse Width Modulation (PWM) or Direct Torque Control designs. These techniques shall provide full nameplate motor voltage as well as distortion free sinusoidal currents at the terminals of the motor to obtain full motor rated torque at rated frequency. The operating characteristics shall not exceed those recommended by the motor manufacturer.

The mechanical design of variable-speed drives shall adhere to the following guidelines;

- the internal layout of the variable-speed drives shall maintain separation between the control signals and the power conductors in order to minimize EMC noise related problems;
- the variable-speed drives shall be assembled in such a way as to facilitate easy maintenance;
- the location of the nameplate or label of the variable-speed drives shall be easily accessible and contain all the necessary information in order to determine the variable-speed drives rating and to also assist with identification;
- all incoming and outgoing cables shall enter and exit from the top and/or the bottom of the variable-speed drives; gland plates shall be provided as standard for the correct fitting of cables with cable glands to ensure safety and reliable operation;
- The variable-speed drives shall be of compact design and have the ability to be mounted side-by-side without separation for greater space saving.

The variable-speed drives enclosure shall be protected to IP20.

1.4.25.3 Standards

The variable-speed drives shall be designed and constructed in accordance with the requirements of the IEEE standards.

The variable-speed drives shall be UL and CUL listed for power conversion equipment for use in pollution degree 2 environments and labeled accordingly.

The variable-speed drives units shall be certified for compliance with the following standards:

BS EN 60146-1-:1993, IEC 60146-1-1:1991	Semiconductor converters. General requirements and line commutated converters. Specifications of basic requirements.
BS EN 60204-1:1998, IEC 60204-1:1997	Safety of machinery. Electrical equipment of machines. General requirements
BS EN 60204-11:2001, IEC 60204-11:2000	Safety of machinery. Electrical equipment of machines. Requirements for HV equipment for voltages above 1000 Vac. or 1500 V d.c. and not exceeding 36 kV

The variable-speed drives, when installed in accordance with the recommendations and guidelines of the variable-speed drives manufacturer, shall comply with the requirements of the EMC Directive as defined by the EMC product standard for power drive systems BS EN 61800-3:1997 "Adjustable speed electrical power drive systems. EMC product standard including specific test methods."

The variable-speed drives shall be factory tested upon asynchronous induction motors using a variety of user parameters. The factory tests shall simulate operation within actual variable-speed drive installations. The variable-speed drive supplier shall provide copies of the Certificates of Type Test.

The variable-speed drives shall meet or exceed the following standards:

BS EN 61800-2:1998, IEC 61800-2:1998	Adjustable speed electrical power drive systems. General requirements. Rating specifications for low voltage adjustable frequency a.c. power drive.
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BS EN 61800-4:2003	Adjustable speed electrical power drive systems. General requirements. Rating specifications for a.c. power drive systems above 1 000 V a.c. and not exceeding 35 kV.
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BS EN 61800-5-1:2003 drive systems. thermal and energy.	BS EN 61800-5-1:2003 Adjustable speed electrical power Safety requirements. Electrical,
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1.4.25.4 Protection functions and features

The variable-speed drives shall include the following protective features in order to ensure the security and safe operation of the plant:

- ability to disable panel buttons whilst in remote control mode
- parameter protection with 2 levels of setting
- automatic restart after a fault, etc.
- expansion to serial communication network using RS485 and simple protocol (USS).
- closed loop internal PID control for regulation.
- ability to have selection between MANUAL and AUTO through use of selector via variable-speed drives digital input terminals.
- ability to provide optional AC line reactors for power factor improvement, harmonic control, prevention of zero voltage notching or surge protection from low impedance supplies.

1.4.25.5 Control signals

The variable-speed drives shall have two analogue inputs (0-10V or 0/4-20mA) and six fully programmable digital inputs.

The variable-speed drives shall accept any of the following speed setting input signals:

- ☐ 0-10V DC;
- ☐ 0-20 mA or 4-20 mA;
- ☐ Motorized potentiometer using up/down digital inputs;
- ☐ Fixed frequencies using digital inputs; RS485;
- ☐ Keypad display for local hand operation.

The variable-speed drives shall have at least one analogue output signal (0/4-20mA) which can be programmed to:

- ☐ output frequency;
- ☐ output current (load);
- ☐ DC-link voltage;

- ☐ motor torque;
- ☐ motor speed;
- ☐ set point frequency.

The variable-speed drives shall incorporate two volt-free outputs (240VAC, 1A) for remote indication of following:

- ☐ motor running;
- ☐ set point speed reached;
- ☐ fault indication (over-temperature, over-current, etc.);
- ☐ PID high and/or low speed limits reached.

The variable-speed drives shall have an RS485 interface as standard allowing the variable-speed drives to be used in conjunction with an external system within a multi-drop LAN configuration. The interface shall allow all the various parameter settings of the variable-speed drives to be programmed via BMS control. In addition, the variable-speed drives shall have the capability to retain these setting within the non-volatile EEPROM memory.

The variable-speed drives shall incorporate a clear and easy to operate user- interface panel. The preferred design is to have a 4 digit green LED display with a membrane keypad.

The information to be displayed in the variable-speed drives display mode shall be:

- ☐ output frequency;
- ☐ speed of motor;
- ☐ status of motor (running, stop, fault, etc);
- ☐ motor current
- ☐ motor torque
- ☐ fault status
- ☐ PID feedback signal
- ☐ DC-link voltage
- ☐ set point frequency
- ☐ motor output voltage
- ☐ serial link status

1.4.25.6 Harmonics on mains supply system

The variable-speed drives and their installation shall comply with the following reference standards: IEEE 519 -"Guide for Harmonic Control and Reactive Compensation of Static Power Converters." Engineering Recommendation G5/3 of the Electrical Council (UK).

1.4.25.7 Electromagnetic compatibility

When installed according to the recommendations of the manufacturer the variable- speed drives product range shall fulfill all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN61800-3.

The variable-speed drives shall have a level of performance to allow the assembler to self- certify their apparatus for compliance with the EMC directive for the industrial

environment as regards the EMC performance characteristics of the power drive system. Performance limits are as specified in the Generic Industrial Emission and Immunity standards BS EN 61000-6-2:1999, IEC 61000-6-2:1999 and BS EN 61000-6-4:2001.

1.4.25.8 Output chokes

The variable-speed drives should be capable of operating normally (without the need for an output choke or reactor) when connected to the motor with a screened / unscreened motor cable length of up to 50m.

1.4.25.9 General services

- **Labels and notices**

Labels shall be provided to describe the duty of or otherwise identify all items of plant, mounted internally and externally, with clear, concise and unambiguous wording. Each label shall be permanently secured to the panel surface adjacent to the item to which it refers but not to trunking covers or other readily removable items, using plated screws.

All component labels shall have circuit designations that can be easily correlated with the drawings. Labels shall be provided on or adjacent to fuse carrier bases, where provided, to indicate the rating of the fuse to be employed. Labels shall be manufactured from laminated plastic or similar white/red/white for danger and warning labels, otherwise white/black/white. Edges shall be beveled and lettering at least 5mm high. In addition to component labels, each cubicle door shall bear a large identification label (minimum lettering size 8mm), whilst each panel shall bear a large overall identification label (minimum lettering size 12mm). In addition to individual terminal numbers each group of terminals shall be provided with a "Function Description" label.

Warning notices, in red lettering on white background, shall be provided on all automatic start-up plant.

Component "stick on" block diagram identification labels shall be fixed to the inside of each cubicle and starter panel. The diagrams shall match the component layouts so that easy identification of all components is possible.

Warning labels shall also be fitted to the capacitor and motor terminal boxes, inscribed as follows: "WARNING - EQUIPMENT CONNECTED TO STORED ELECTRICAL CHARGE. ISOLATE AND EARTH ALL TERMINALS BEFORE HANDLING".

- **Shrouding**

Shrouding shall be provided such that it is not possible to touch a live conductor, with or without a tool, unless a positive step has been taken (using a tool) to remove a cover, shroud, etc. All such covers and shrouds shall bear adequate labels identifying the potential danger.

- **Control circuits**

All circuits shall be designed as far as possible to fail to safety. Generally, control relays shall de-energize for the safe condition.

Safety interlocks, designed to prevent injury to personnel or damage to plant, shall be direct in operation.

Circuits shall be as simple as possible subject to necessary operational and safety constraints, involving a minimum number of components.

Where automatic control of several items of plant is provided by a PLC, then a simple back-up automatic control system, independent of the PLC, shall be provided to give rudimentary unmanned control in the event of PLC failure. Such a system needs not to be efficient or even

provide 100% plant availability, but it shall come into operation automatically in the event of normal control system failure.

- **Steel conduit and fittings**

Steel conduits and fittings shall comply with BS 4568-1:1970 or BS EN 50086- 1:1994. Distance type saddles shall be used for all surface exposed steel conduits.

Conduits shall be installed in such a manner that all cables can be drawn in after erection by means of a draw-in tape. Conduit joints shall be painted with approve metallic paint. Elbows and tees shall be avoided where practicable, and normal bends or sets used. Exposed outlet boxes shall be cast metal types, and flush boxes shall be cast or sheet metal. No knock-outs shall be removed unless used. Where conduits enter sheet metal boxes they shall be locked-nutted back and front. Burrs and obstructions shall be removed before installation of boxes and conduits.

No conduit shall be smaller than 20mm in diameter.

Boxes shall generally be galvanized steel, small, circular 60mm types with steel covers.

Adaptable boxes shall be galvanized steel with overlapping lids but without "knockouts".

Box covers shall be fixed by brass round or cheese head screws.

- **Plastic conduit and fittings**

Plastic conduit, where approved for use by the Engineer, shall comply with BS EN 50086-1:1994 and BS EN 50086-2-1:1996 and be heavy gauge, high impact. Fittings, fixings and accessories shall be of the same manufacture and color as the conduit.

All accessories shall be fitted with earthing terminals.

- **Trunking**

Trunking shall be heavy duty, galvanized, to BS 6946:1988 or BS EN 50085-1:1999.

- **Cable tray and accessories**

Cable trays shall be to BS EN 50085-1:1999 or BS EN 61537:2002, IEC 61537:2001.

Galvanized cable tray shall be perforated, heavy duty return flange type, hot dipped galvanized after manufacture.

Plastic coated cable tray shall be diamond pattern, heavy duty, black PVC covered. Rigid PVC

cable tray where approved for use by the Engineer, shall be

manufactured from rigid unplasticised PVC having a thickness of not less than 3mm.

It shall be perforated and have provision for a cover. The material of manufacture shall be self-extinguishing or non-flammable and suitable for use in ambient temperature of -20 oC to +80oC.

Fixings shall be carried out using manufacturer's recommended brackets and supports.

- **Low water level sensors**

Low water level electrode sensor units shall be provided within all boreholes and within certain storage tanks and water inlet chambers. The sensors shall be supplied complete with all required

cabling, fixings and terminations. The units required for installation within the boreholes shall be complete with two clips for each length of riser.

- **Sump pump controls**

Submersible drainage pump units shall be supplied complete with suitable float operated on-off controls. The pump units shall be supplied with control panels/starter units as specified, cables, supports, and fixings as required.

- **Co-ordination**

The Contractor shall be fully responsible for the necessary liaison and co-ordination of all works on site.

Cable runs shall be to suit pipe work, drainage, cables, foundations and the like. The Contractor shall produce drawings for approval indicating the proposed routes of his cable. These shall in general follow an agreed service reserve.

- **Locks**

Sufficient padlocks with individual keys of a type approved by the Engineer shall be provided for locking the following items:

lockable, lock-off, isolating fuse switches and feeder pillars and the like, and inter-locks, lock-off, ACB's (and/or Castelle interlocks)

Each shall be provided with four keys and be individually identified.

- **Continuity**

All conduits, trunking, duct, cable tray, etc, shall be mechanically and electrically continuous thought. Where steel conduits cross expansion joints, flexible steel conduit sections, PVC served, shall be inserted, or other approved means used to provide the necessary continuity and flexibility.

- **Radiated interference**

The Contractor shall ensure that radiated interference from all items of Plant is suppressed to the limits specified in BS EN 55014.

1.4.26 Earthing

1.4.26.1 General

The system of earthing on the LV reticulation will generally be TN-S as defined in the IEE Wiring Regulations (16th Edition). Earthing systems shall comply with BS 7430:1998 and the current edition of the IEE Wiring Regulations. Separate earth protective conductors shall be employed throughout on mains, sub-mains and all final circuits.

As a minimum the metalwork of all items of electrical plant, electrical system neutral points, power and control cable armoring and screens, and extraneous metalwork including structural steelwork and pipe work, shall be connected to the earthing installation.

Earthing continuity in non-electrical plant shall normally be achieved via metal to metal faces, metal hinges, and metal fixings. Earth straps shall only be supplied where earth resistance is high or there is risk of corrosion or similar which could in the future increase resistance and affect earth continuity.

All structural steelwork within the site shall be bonded to the earthing system.

All pumping plant shall include an earth continuity conductor or tape which shall extend from the pump/motor frame/bed plate to the main station/switchboard earthing system.

The final arrangement of the earth electrode system shall be to the requirements of the supply authority and to the satisfaction of the Engineer.

The earth resistivity at the sites may vary and the Contractor shall include for taking earth resistance readings both before and at least once during construction, and one final reading, at every earth point to ensure the Specifications values are obtained.

Each system shall be varied according to the immediate location. Each local earth system shall be installed progressively until the value of earth resistance is obtained to the satisfaction of the Engineer.

At the various sites an earth busbar system shall be supplied, connected to earth electrodes, to which the following shall be connected:

- ☐ star points of all transformers on the medium voltage side.
- ☐ sheathing of cables.
- ☐ metalwork at the sites, other than carrying cables.
- ☐ earth wires from plant, external to main pump stations, that is fed only from that pump station.
- ☐ main incoming water pipes.
- ☐ the building metallic structure.
- ☐ the lightning protection system where provided.

The earthing continuity of each metal sheathed cable shall be maintained by efficient bonding between the cable sheath, the gland, and the metal case of the switchgear or other metal clad accessory or appliance at which the cable terminates. In addition, ICEW's or BCEW's shall be run with all cables.

Three-core cables may be used to single phase items of plant, the third conductor being used as the insulated copper earthwire.

The size of all earth wires bonding plant to a main earthing system shall be such that a current of three times the fuse rating of the circuit or one and one half times the overload setting of the circuit breaker can flow without adverse effects.

All joints between wires and other earthing metalwork shall be mechanically sound and soldered.

The earth leads shall be insulated until the connection is made to the electrode system. A bolted test link shall be installed to facilitate regular testing of the earth electrode system resistance.

The insulation of the earth lead shall be insect and rodent resistant.

All materials used in any earthing installation shall be adequately protected against corrosion and earth leads shall be protected against any mechanical damage.

1.4.26.2 HV Earthing systems

Where pole mounted high voltage load/air-break isolators and fused-cuts are installed, the operating handle of the isolator shall be separately and effectively

bonded to a potential earth mat suitably placed for the Operator to stand upon. In addition, a standard earth electrode system shall be installed at the bottom of the relevant pole. The earth tape of all the high voltage hardware steelwork and to the transformer tank shall be connected to a separate earth electrode system outside the influence of other earth mats.

Copper earth conductors, for the overhead line structures, shall be 70mm² in cross sectional area. They shall be protected from pilfering by a length of 50mm² diameter galvanized water pipe sunk into the ground and terminating 2,500mm up the supporting structure and securely clamped to the supporting structure. The ends shall be sealed by suitable means after installation of the cables.

Where outdoor plinth mounted transformers are installed, all boundary fencing fabricated of current carrying materials shall be effectively connected to the low voltage earthing system along the peripheral length. The fence shall be bonded to the electrodes and shall be provided with protective bonding across all gates, these bondings being flexible and protected.

1.4.26.3 Installation

The earthing installation shall comprise an earth terminal, earth busbars, circuit, earthing conductors, equipotential bonding conductors, and main earthing conductor and earth electrodes. The circuit earthing and equipotential bonding conductors shall be of the radial, grid or ring form as dictated by the plant layout.

The earthing installation shall be protected from mechanical damage and corrosion. Joints in tape conductors shall be riveted and soldered, brazed, clamped, bolted or exothermically welded. Non-corrosive flux shall be used for soldered joints. Clamped and bolted type joints shall be tinned and shall only be used above ground.

The interconnection of conductors below ground shall be by means of exothermic welding or brazing. Compression type lugs shall be provided for the termination of cables.

Earthing conductors shall be buried directly in the ground or secured to building structures, cable racks and trays using proprietary fixings.

Where the soil is aggressive to copper, buried earthing conductors shall be protected by an approved sleeving.

An equipotential bond shall be provided to all buried metal pipe work at the point of entry into a building or chamber where electrical apparatus is installed. Electrical continuity across all pipe joints within the structure shall be ensured. Where pipe work incorporates a compression coupling (e.g. Viking-Johnson coupling), a bond shall be provided to any isolated section.

Cable armoring and screens shall be bonded to earth at both ends unless otherwise specified. Cable armour shall not be used as the sole earth protective conductor.

1.4.26.4 Conductors

Circuit and main earthing and equipotential bonding conductors shall be high conductivity copper tape or 1000 V grade PVC insulated multi-stranded cable. PVC cable insulation shall be striped green/yellow. Cable lengths shall be continuous and intermediate jointing is not permitted.

The main bonding conductor shall be not less than 16mm² and supplementary bonding of non-electrical plant not less than 10mm². All connections shall be made using compression type cable lugs, taped on completion to completely seal the lug and any bare copper from the atmosphere. The surface to which earthing bonds are fixed shall be cleaned free from paint and other non-conducting material and coated with petroleum jelly.

The Contractor shall provide the following supplementary bonding conductors which shall be made in 2.5mm² cable if mechanically protected, or 4mm² if not mechanically protected:

- ☐ all sink and shower units to pipe work
- ☐ all small power outlets and sink units within a 2.5 m radius of each other
- ☐ all metallic tanks

1.4.26.5 Earth electrodes

Earth electrodes where used shall be copper or copper clad high tensile steel rods having minimum copper thickness of 0.25mm and outer diameter not less than 16mm. The rod shall penetrate a minimum of 2,400mm below ground level. Where multi-rods are used a distance of not less than the driven length shall separate them.

Earth rods shall have hardened tips and caps and be extendable. Bare copper tape buried at a minimum depth of 600mm shall be used for interconnection of rods.

Where soil conditions make the use of rods type electrodes impracticable a grid configuration may be used comprising horizontally buried bare high conductivity copper tape of dimensions 15mm x 4mm minimum. Tape shall be buried at a minimum depth of 600mm.

All earth electrodes shall be buried in a mixture of well ground charcoal and common salt in a ratio of 2:1.

Earth rods shall be provided with a non-ferrous clamp for the connection of the earthing conductor. Each connection between conductor and earth electrode shall be suitably protected against corroding elements in the soil with bituminous tape.

The connection shall be made in a concrete inspection chamber set flush with the finished ground level. The inspection chamber shall be permanently marked "ELECTRICAL EARTH".

Marker posts and plates shall be provided to mark the position of the electrodes and buried connections. The markers shall be similar to those provided for cable routes.

1.4.26.6 Main earthing terminal

Where specified, a main earth terminal shall be installed in a convenient location. This shall comprise a high conductivity copper bar of sectional area at least that of the main earthing conductor. The terminal shall be supported on porcelain barrel type insulators and wall-mounted.

The terminal shall be of sufficient length to accommodate, with 25% spare capacity, bolted copper tape connections to:

- ☐ the earthing conductor(s) between the earth terminal and earth electrodes
- ☐ circuit protective conductors between the earthing terminal and exposed conductive parts

- the main equipotential bonding conductors between exposed and extraneous conductive parts
- the system neutral earthing conductor (where specified)

Facilities (i) and (iv) shall be removable with a tool to permit measurement and testing.

Earth studs shall have a minimum size of M8.

1.4.26.7 Earthing of buildings

Earthing of all electrical apparatus, circuits and outlets shall be carried out in accordance with the requirements of the local supply authority and the relevant wiring regulations. All metal conduit and metal sheaths of cables shall be bonded to the metal work of their termination gear.

Each building shall have an associated terminal to which all metal bodies requiring to be earthed shall be connected. The earth terminal shall be connected by an earthing lead to an effective earth electrode situated as near as practicably possible to the building earth terminal.

The earth lead shall not be smaller than 25mm² insulated stranded copper conductors.

The resistance from the earthed end of the earthing lead to any earth continuity conductor in a building installation shall not exceed 0.2 Ω .

The measured resistance of the earth electrode shall not exceed 1 Ω

All metal external water pipes, drainpipes, down pipes, conduit and guttering shall be securely earthed, contact surfaces being thoroughly cleaned and connections made by soldering on by means of copper clamping bands with non-corroding bolts in accordance with the relevant standards. Wire used shall be stranded copper of not less than 4mm².

1.4.26.8 Tests on site

On completion of the earthing installation the Contractor shall measure the resistance of each electrode installation and of each complete earthing system to the general body of the ground. All other tests stipulated in the Reference Standards shall also be carried out.

The Contractor shall carry out tests to verify that exposed metalwork within the buildings is effectively bonded and install supplementary bonding connections as necessary to ensure proper continuity. In particular supplementary bonding shall be provided to individual suspended systems throughout the buildings.

The resistance to earth of each complete network shall not exceed 5 Ω .

1.4.26.9 Lightning protection

Where buildings, structures or sections of the plant are to be protected against lightning or static charges, an earthing system shall be provided. The installation shall be carried out in accordance with BS 6651:1999.

The down run conductor shall be of hard drawn high conductivity copper of 25mm x 3mm section. The tape shall be fixed to the outside of the structure by means of stand off saddles. Where indicated, connections shall be made to the concrete reinforcing. The route of the tapes and the fixings shall be discussed with the Engineer before installation.

Where the conductors specified shall be PVC insulated to prevent corrosion and to blend with the building fabric.

A test link shall be installed in each down conductor adjacent to the earth rod at a height of 1,200mm above ground level. The overall resistance of the earth termination system to earth shall not exceed 10 Ω . If this requirement is not met the number of earth electrodes shall be increased or they shall be interconnected until a value of 10 Ω is attained.

Earth rods shall be not less than 16mm diameter copper or copper-clad steel, provided with hardened tips and driving caps. Each rod shall be provided with a

non-ferrous clamp for connections of the copper strip. Each connection shall be housed in an inspection chamber set at ground level.

Where feasible, the lightning protection grounding system may be inter-connected with the system earth to ensure equipotential under all conditions.

1.5 MECHANICAL INSTALLATIONS

1.5.1 Pumps

1.5.1.1 Pump Selection

In selecting pumps the following factors shall be considered:

- Quality of water (corrosivity, abrasiveness);
- Suction head and draw-down (in boreholes);
- Borehole casing diameters and positions of screens;
- Power supply characteristics;
- Hydraulic characteristics of the supply system;
- Pump cost and operating costs;
- Hydraulic efficiency;
- Availability of operation and maintenance services;
- Standardisation of equipment

Large pumps in low lift stations shall preferably be of the vertical turbine type. Smaller low lift pumps may be either horizontal or vertical.

High lift pumps shall preferably be horizontal, for ease of maintenance and longer life. Wherever possible a single-stage pump shall be preferred to a multi-stage, and

lower speed motors are preferable to high-speed motors. It is not considered advisable to use multi-stage high speed pumps due to increased wear despite possible initial costs savings.

Every pump shall be provided with a non-return valve, gate valve, air release valve, pressure gauge and flow detection switch.

Borehole pumps shall in addition be equipped with a level measurement instrument and an automatic low-level protection switch. Provision shall be made for metering the production of each system, and for flow-recording at larger stations.

1.5.1.2 General Pump Design

Pumps shall be arranged for priming by means of an adequate positive suction head in all possible operating conditions and be driven by electric motors, unless otherwise specified.

Pump shafts shall be forged from a material compatible with the impellers. If the pumps are fitted with packed glands, the shafts shall be provided with replaceable sleeves where they pass through the gland.

Pumps may be fitted with mechanical seals in place of packed glands only if they have proved satisfactory over a long period when fitted to the design pump in question and with prior approval. They shall be designed for easy adjustment and seal removal.

Effective means shall be provided for the collection of gland leakage water and piping it to a suitable floor drain.

Intake pumps for surface water duty shall be designed for pumping raw water with a high silt content, to be capable of passing 75 mm diameter solids and to avoid possible choking by weeds or other tough sinuous material.

Lubrication arrangements shall be designed to avoid any contamination of the pumped fluid. Unless otherwise specified, all pump bearings shall have a design running life of not less than 100,000 hours.

Bearings shall be designed for loadings 20% in excess of calculated maximum loading and shall be suitable for reverse rotation at 150% rated speed or the maximum reverse speed the pump can reach in installed conditions when driven backwards by reverse flow, if this is greater. Bearing cooling arrangements if used shall be designed on the closed-circuit principle. Open discharge of cooling water into the pumping station drainage system is not permissible.

The rotating assemblies shall be statically and dynamically balanced and designed so that the first critical speed of the pump and its drive is at least 50% higher than the maximum operating speed. Where the rotating assemblies are small and any out of balance forces are negligible this requirement will not be necessary. The manufacturer is required to state whether balancing has been completed.

The speed of any main pump shall not exceed 1500 rpm without approval of the Engineer.

The head/quantity characteristic of any pump shall be stable at all rates of flow between close and open valve and shall be steep enough to permit satisfactory operation in parallel with other pumps under all conditions specified.

The pump efficiency shall be well maintained over the whole of the specified duty range, even if this necessitates the use of a larger motor to provide the peak power demand. For vertical spindle suspended pumps the pump efficiencies quoted shall

take into account shaft and rising main losses up to and including pump discharge bend and pump coupling.

The NPSH requirements of the pumps, based on the 2% output drop criterion shall be at least 1 m less than the NPSH available at every working condition.

Water velocities in the suction or delivery branches of a pump shall not exceed 3.5 m/s when the pump is operating within its specified duty range and within this working range there shall be no discernible noise due to hydraulic turbulence or cavitations within either the pump or its associated pipe-work and valves.

Each pump shall be complete with all necessary ancillary equipment and fittings to render the unit complete and ready for service. This shall include isolating valves, non-return valves, air-valves, cooling water pipe-work, gland leakage pipe-work, air release pipe-work, pressure gauges, gauge pipe-work, holding down bolts, access platforms and other items as appropriate.

1.5.1.3 Pump Performance Guarantee

The pump performance guarantee shall relate to the flow rate, the total head and the efficiency of the pump when tested at the manufacturer's works.

The pump shall operate at its design point within the acceptance tolerances for flow rate and total head laid down in SSRN 016.

1.5.1.4 Materials of Construction

The pump impeller, shafting, sleeves, wear rings, casing, etc. shall be of suitable material to cope with the pumped medium and the Tenderer shall have satisfied himself that sufficient detail has been provided to make this assessment.

Typical materials of pump construction have been given in the following Clauses and are intended only as a general guide.

1.5.2 Electro Submersible Borehole Pumps

Borehole pumps shall be of the totally submersible radial or mixed flow borehole type, having zinc free bronze casings and impellers and high tensile steel shafts and fittings. The pumping units shall be suitable for continuous operation.

The pump body shall have separate sections for each stage, which shall have matching faces machined and spigotted, to allow accurate location and alignment of the sections during assembly. The fixing nuts, bolts, washers and studs or bolts shall be manufactured in stainless steel material. The pump shall be fitted with removable shaft bearing sleeves, bearing brushes, casing wear rings and impeller wear rings. Each impeller shall be located on the shaft by identifiable distance sleeves or similar, such that reassembly of the rotating element can be carried out without the necessity of accurate measurement. The rotating assembly shall be statically and dynamically balanced after which each part of the assembly shall be identified and marked to ensure identical reassembly after maintenance, etc.

Bearings shall be water lubricated and where rubber type bearings are used the bearing material shall be securely bonded to a metal housing. Rubber bearings shall only be used where there is sufficient pressure difference through the bearing to afford adequate lubrication and cooling of the bearing, and where the bearing is submerged under all operating and starting conditions. Natural rubber shall not be used under any circumstances.

Bearings shall be positively retained within the pump body to prevent the possibility of the bearing rotating; a press fit alone is not acceptable.

The pump shall be directly coupled to its drive motor and shall be fitted with a lifting disc type check valve. The check valve shall be designed for a minimum friction loss and shall have its disk drilled with a suitably sized hole, to allow the water column to fall on cessation of pumping, without excessive reverse rotation of the pump.

The pump shall be fitted with a suction case of a material suitable for the liquid being pumped and shall be provided with long bearings to stabilise the shaft and motor shaft and to avoid radial thrust on the motor bearing. A screen shall be incorporated having a minimum open area of 4 times the eye of the impeller.

The submersible motor shall be of the completely enclosed type for continuous duty under water operation on 415V, 50 Hz, 3 phase ac. The motor shall be equipped with an approved seal, located in the top of the motor where its shaft extends through the motor housing, to isolate the well water from the liquid filled motor. The liquid shall be either water or a high dielectric strength mineral oil and it shall be circulated throughout the motor for cooling the motor, stator winding and bearings. Motor performance shall be in accordance with the relevant section of SSRN 011 and SSRN 022.

Motor thrust bearing ratings must be ample to carry the thrust load imposed by the pump when operating under the maximum anticipated pumping head. Motor thrust bearings shall be capable of operating with rotation in either direction, and the thrust capacity when operating in reverse shall not be less than the rated capacity.

An expansion chamber or diaphragm shall be provided to relieve thermal expansion of internal motor fluid due to temperature and shall provide motor internal and external pressure balance under all conditions of temperature and pressure.

The drive shaft shall be a 13% chromium steel or equivalent corrosion resistant material. Outer shell shall not be less than 0.012 m thickness and shall be of material to resist corrosion.

The borehole pump column pipe shall be manufactured from steel pipe coated with an epoxy bituminous solution or similar approved.

The column pipe shall comprise a number of sections at the option of the Contractor such that for each well the total length may be adjusted by plus or minus 2 m. A maximum of three different lengths shall be supplied. Column pipes and fittings supplied in accordance with this requirement in excess of that installed shall become the property of the Purchaser which shall be in addition to those ordered as specified for spare parts.

The sections shall be connected by either welded neck flanges or screwed couplings. Welded neck flanges shall be suitably notched or similar to facilitate installation of the motor power cable and level sensing equipment. Where screwed couplings are used the couplings shall be coated with a PTFRE anti-galling compound.

The borehole pump surface plate assembly shall consist of a steel base plate of the required strength to carry the weight of the complete pumping unit. The surface plant shall be supplied with a flanged sleeve to fit over the well casing. The sleeve shall be fitted with a puddle flange for building in. The couplings shall be screwed on to the upper end of the column pipe and shall have a long radius flanged bend.

The plate shall be provided with suitable openings for the power cable, well vent and water level indicator, as required.

1.5.3 USER TRAINING

A person shall be identified from the institution, which shall regulate the system usage and carry out routine maintenance of the systems. This person shall be provided with user training covering the following:

- System performance expectations and limitations
- Purpose of each component of the system
- How to operate and use the systems including safety
- Indicator Lights and their purpose
- How to deal with breakdowns
- Performance monitoring and data recording
- User manuals shall be availed at every institution

1.6 BILLS OF QUANTITIES

NOTE:

1. In case of discrepancy between unit price and total price, the unit price shall prevail
2. Bidders can quote for all the lots but a bidder can only be awarded one lot.

1.6.1 Preamble to Bills of Quantities

The objectives of the Bills of Quantities are;

- a) to provide sufficient information on the quantities of Works to be performed to enable tenders to be prepared efficiently and accurately; and
- b) When a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

The Bills of Quantities should be divided generally into the following sections:

1.6.1.1 Preliminaries

The preliminaries should indicate the inclusiveness of the unit prices, and should state the methods of measurement which have been adopted in the preparation of the Bill of Quantities and which are to be used for the measurement of any part of the Works.

The number of preliminary items to be priced by the tenderer should be limited to tangible items such as site office and other temporary works, otherwise items such as security for the Works which are primarily part of the Contractor's obligations should be included in the Contractor's rates.

1.6.1.2 Work Items

- i) The items in the Bills of Quantities should be grouped into sections to distinguish between those parts of the Works which by nature, location, access, timing, or any other special characteristics may give rise to different methods of construction, or phasing of the Works, or considerations of cost. General items common to all parts of the Works may be grouped as a separate section in the Bill of Quantities.
- ii) Quantities should be computed net from the Drawings, unless directed otherwise in the Contract, and no allowance should be made for bulking, shrinkage or waste. Quantities should be rounded up or down where appropriate.
- iii) The following units of measurement and abbreviations are recommended for use:

<i>Unit</i>	<i>Abbreviation</i>	<i>Unit</i>	<i>Abbreviation</i>
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cubic meter	m ³ or cu m	millimeter	Mm
Hectare	Ha	Month	Mon
Hour	H	Number	Nr
Kilogram	Kg	square meter	m ² or sq m
lump sum	Sum	square millimeter	mm ² or sq mm
Meter	M	Week	Wk
metric ton (1,000 kg)	T		

- iv) The commencing surface should be identified in the description of each item for Work involving excavation, boring or drilling, for which the commencing surface is not also the original surface. The excavated surface should be identified in the description of each item for Work involving excavation for which the excavated surface is not also the final surface. The depths of Work should be measured from the commencing surface to the excavated surface, as defined.

1.6.1.3 Day-work Schedule

- i) A Daywork Schedule should be included if the probability of unforeseen work, outside the items included in the Bill of Quantities, is relatively high. To facilitate checking by the Employer of the realism of rates quoted by the tenderers, the Daywork Schedule should normally comprise:
- ii) a list of the various classes of labour, and materials for which basic Day work rates or prices are to be inserted by the tenderer, together with a statement of the conditions under which the Contractor will be paid for Work executed on a Day work basis; and
 - iii) a percentage to be entered by the tenderer against each basic Day work Subtotal amount for labour, materials and plant representing the Contractor's profit, overheads, supervision and other charges.

1.6.1.4 Provisional Quantities and Sums

- i) Provision for quantity contingencies in any particular item or class of Work with a high expectation of quantity overrun should be made by entering specific "Provisional Quantities" or "Provisional Items" in the Bill of Quantities, and not by increasing the quantities for that item or class of Work beyond those of the Work normally expected to be required. To the extent not covered above, a general provision for physical contingencies (quantity overruns) should be made by including a "Provisional Sum" in the Summary of the Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a "Provisional Sum" in the Summary of the Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises.
- ii) Provisional sums to cover specialized works normally carried out by Nominated Sub Contractors should be avoided and instead Bills of Quantities of the specialized Works should be included as a section of the main Bills of Quantities to be priced by the Main Contractor. The Main Contractor should be required to indicate the name (s) of the specialised firms he proposes to

engage to carry out the specialized Works as his approved domestic sub-contractors. Only provisional sums to cover specialized Works by statutory authorities should be included in the Bills of Quantities.

1.6.1.5 Summary

The Summary should contain a tabulation of the separate parts of the Bills of Quantities carried forward, with provisional sums for Daywork, for physical (quantity) contingencies, and for price contingencies (upward price adjustment) where applicable.

1.6.2 BILL OF QUANTITIES

LOT 2 - SOLAR PLANT AND BOREHOLE EQUIPPING

BILL OF QUANTITIES FOR SUPPLY, INSTALLATION, TESTING COMMISSIONING OF SOLAR WATER PUMPING POWER SYSTEMS TO EXISTING BOREHOLE AT RUMBIYE COMMUNITY - FUNYULA					
S/No.	Description	Unit	Qty	Rate (Ksh)	Amount (Ksh)
A	Preliminaries				
A1	Mobilization, setting up and demobilization along with necessary accessories to and from the site, including site clearance	Sum	1		
A2	Provisional sum for removal of existing handpump, retrieval of drawoff pipes/rods and handover to client for safe storage	PC	1		
B	Supply, Installation, Testing and Commissioning of Solar PV plant and pumping system for water supply				
	Contractor to submit design drawings for approval				
B1	Submersible Solar pump - 7.5Kw coupled with motor.	Sum	1		
B2	550 Watts Mono-Crystalline solar modules	Pcs	18		
B3	Supply and Install Solar Pump Controller/Power Inverter matching the selected PV generator and the pump rating - with hybrid and VFD capability (with mains and solar PV input and automatic changeover)	Nr	1		
B4	6mm ² 4core flat Submersible drop Cable	Mts	158		
B5	6mm ² 4Core UG Cables	Mts	20		
B6	6mm ² x2 Solar PV Cables	Mts	60		
B7	1.5mm ² x 2 Core well probe Cable	Mts	170		
B8	Well probe sensor	Nr	1		
B9	Surge Arrestor complete with accessories	Sum	1		
B10	PV Disconnect Isolator 1000V/32A	Pcs	1		
B11	Heavy Duty uPVC Borehole drawdown pipes 1.5"	Mts	156		
B12	PVC pipes 25mm, class B	Mts	160		
B13	Borehole cover sundries , Juction Box, nipples, Bend and all fittings	UNIT	1		

B14	Water Meter 1.5"; Min R=160	Pcs	1		
B15					
B16	Allow for sufficient earthing of system as per IEC standards	Sum	1		
B17	Lightning Arrestor (With required accessories)	Sum	1		
B18	Other Electrical sundries - Supply and installation (adaptoe set, splicing kits, looping boxes, etc.)	Sum	1		
C	Civil Work (Contractor to submit civil design drawings for approval)				
C1	Design, fabricate, supply and install solar module steel support structure with a minimum height of 4.5m from ground level. Casting of solar modules support structures to be done in RC Concrete G25/20 footings. Depth of footings to be confirmed and approved by the engineer on site.	Sum	1		
C2	Chainlink Fencing specifications: Chainlink - 6ft width, 80x80mm mesh size, 14gauge Strainer wire - 14gauge, galvanized wire X 4 strands. Barbed Wire - High tensile, 16gauge, Poles - Concrete poles overall Height, 8ft, 100x100mm cast in concrete grade 15 base (0.5X0.5X0.6m) placed at 3mts C/C.				
	Fencing as described above of 10M x 15M sq area with a single leaf steel gate as per standard drawings.	Sum	1		
	TOTAL SUM				
	VAT (16%)				
	CONTIGENCY (5%)				
	GRAND TOTAL				

2 SECTION IV: CONDITIONS OF CONTRACT (Including erection on site)

2.1 PART I – GENERAL CONDITIONS

PART I – General Conditions, shall be those forming Part I of the “Conditions of Contract for Electrical and Mechanical Works – Including Erection on Site, Third Edition 1987, re-printed 1988 with Editorial Amendments” prepared by the Federation Internationale des Ingenieurs – conseils (FIDIC). The Conditions are subject to variations and additions set out in Part II hereof entitled “Special Conditions”.

Note

- i. The standard text of the General Conditions of Contract must be retained intact to facilitate its reading and interpretation by tenderers. Any amendments and additions to the General Conditions, specific to a given Contract, should be introduced in the Special Conditions or in the Appendix to Form of Tender.
- ii. The Special Conditions take precedence over the General Conditions of Contract.

2.2 PART II – SPECIAL CONDITIONS

(The Clauses referred to in Part II – Section A are those where the provision in the General Conditions (Part I) refer to an alternative solution to be stated in Part II. The provisions in the General Conditions will apply unless an alternative solution is given in Part II – Section A. The clauses in this section need therefore not be completed, but must be completed if alternative solutions to the relevant Part I provisions are necessary.)

2.2.1 Conditions Precedent to Commencement (Sub-clause 1.1.1.)

The following financial and administrative requirements are conditions precedent to commencement: Submission of performance bond.

2.2.2 Defects Liability Period (Sub-clause 1.1.11.)

The Defects Liability Period is **Twelve Months**.

2.2.3 Operation and Maintenance Manuals (Sub-clause 6.6.)

Operation and Maintenance Manuals shall be in **English language**.

2.2.4 General Obligations (Sub-clause 8.1.)

- 6.1 The following facilities will be provided by the Employer: NONE.
- 6.2 The facilities will be provided at the following rates: N/A

2.2.5 Performance Security (Sub-clause 10.1)

The Contractor shall obtain a Performance Security of **10% of the contract price**.

2.2.6 Contractor Equipment (Sub-clause 14.1)

The following items of Contractor's Equipment will be provided free of charge by the Employer for the Contractor's use: **None.**

2.2.7 Price Variation

Contract price variation **shall not be allowed.**

2.2.8 Delayed Payment (Sub-clause 33.6.)

There shall be no interest on delayed payment.

2.2.9 Customs and Import Duties (Sub-clause 48.1.)

The Contractor shall pay for customs, import duties and taxes in consequence of the importation of the Plant.

2.2.10 Arbitration (Sub-clause 50.2)

The rules of arbitration shall be those contained in the Arbitration Act of the Laws of Kenya.