

JARAMOGI OGINGA ODINGA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

TENDER DOCUMENT

FOR

**TENDER NUMBER JOOUST/ONT/A1/27/2019-2020: TENDER FOR
ELECTRICAL/GENERATOR/UPS INSTALLATION WORKS FOR
ADMINISTRATION BLOCK AT THE MAIN CAMPUS - BONDO, SIAYA
COUNTY**

CLOSING DATE 22nd JULY 2020

OPENING DATE 4TH AUGUST 2020

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INTRODUCTION

- 1.1 This standard tender document for procurement of works has been prepared for use by procuring entities in Kenya in the procurement of works (i.e Electrical and Mechanical Works – Including Erection on Site)
- 1.2 The following guidelines should be observed when using the document:-
- (a) Specific details should be furnished in the tender notice and in the special conditions of contract (where applicable). The tender document issued to tenderers should not have blank spaces or options.
 - (b) The instructions to tenderers and the General Conditions of Contract should remain unchanged. Any necessary amendments to these parts should be made through Appendix to instructions to tenderers and special conditions of contract respectively.
- 1.3 (a) Information contained in the invitation to tender shall conform to the data and information in the tender documents to enable prospective tenderers to decide whether or not to participate in the tender and shall indicate any important tender requirements
- (b) The invitation to tender shall be as an advertisement in accordance with the regulations or a letter of invitation addressed to tenderers who have been prequalified following a request for prequalification.
- 1.4 This document is based on PART 1 of the third Edition of the International Federation of Consulting Engineers (Federation Internationale des Ingenieurs Con Seils – FIDIC) Conditions of Contract for Electrical and Mechanical Works, 1987 (reprinted May 1988 with Editorial Amendments).
- 1.5 The cover of the tender document should be modified to include:-
- i. Tender number.
 - ii. Tender name.
 - iii. Name of procuring entity.
 - iv. Delete name and address of PPOA

SECTION 1

SECTION I INVITATION TO TENDER

TENDER REF NO: **JOOUST/ONT/A1/27/2019-2020**

TENDER NAME: TENDER FOR ELECTRICAL/GENERATOR/UPS INSTALLATION WORKS FOR THE ADMINISTRATION BLOCK AT MAIN CAMPUS - BONDO, SIAYA COUNTY

- 1.1 Jaramogi Oginga Odinga University of Science and Technology invites sealed bids from eligible candidates for Tender for Electrical, Generator/UPS Installation for Administration Block at Main Campus - Bondo, Siaya County.
- 1.2 Tender documents with detailed specifications shall be downloaded free of charge at the University website www.jooust.ac.ke and Public Procurement Information Portal www.tenders.go.ke. Tenderers who download the tender document and intend to submit a bid are required to submit their particulars to the University through email: proc@jooust.ac.ke for the purpose of receiving any further clarification and/or addendum.
- 1.3 **THERE SHALL BE MANDATORY SITE VISIT TO BE HELD ON 8TH JULY 2020 FROM 10 AM AT THE ADMINISTRATION BLOCK SITE IN THE MAIN CAMPUS**
- 1.4 Dully filled tender documents are to be enclosed in plain sealed envelopes, marked with the tender number, tender description **and bearing no indication of the applicant**, clearly /marking each “**ORIGINAL TENDER**” and “**COPY OF TENDER**” should be deposited in the tender box at Jaramogi Oginga Odinga University of Science and Technology or be addressed to:-

The Vice Chancellor,
Jaramogi Oginga Odinga University of Science and Technology,
P.O. Box 210-40601
BONDO.

- 1.5 The tender document should reach on or before **22nd JULY 2020**
- 1.6 Due to COVID-19, the application documents will be open on **4TH AUGUST 2020** at the Assembly Hall, Main Campus in the presence of the candidates or their representatives who choose to attend.

NB: Due to ministry of health instructions on social distancing, the number of bidders/representatives will be limited

- 1.7 **BIDDERS MUST SERIALIZE THE BID DOCUMENT. THE UNIVERSITY SHALL NOT BEAR RESPONSIBILITY FOR THE LOSS OF ANY DOCUMENT.**

SECTION II:

INSTRUCTIONS TO TENDERERS

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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.

GENERAL

1. Definitions

- (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 a Central Government Ministry, Local Authority, State Corporation or any other Public Institution.

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, the tenderer shall be required to update the following information already submitted during prequalification:-
 - (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 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.
- (e) 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 accepted. Any change in the Program or Schedule shall be subjected to the approval of the Engineer.
- (f) 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.

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.
- 3.2 The price to be charged for the tender document shall not exceed Kshs.5,000/=
- 3.3 The procuring entity shall allow the tenderer to view the tender document free of charge before purchase.

4. Site Visit

- 4.1 The tenderer is advised to visit and 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.
- 4.2 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 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.
- 4.3 The Employer shall organize a site visit at a date to be notified. A representative of the Employer will be available to meet the intending tenderers at the Site.

Tenderers must provide their own transport. The representative will not be available at any other time for site inspection visits.

Each tenderer shall complete the Certificate of Tenderer's Visit to the Site, whether he in fact visits the Site at the time of the organized site visit or by himself at some other time.

TENDER DOCUMENTS

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. Drawings
- p. 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".

6. Inquiries by tenderers

61 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.

62 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.

63 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.

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.

PREPARATION OF TENDERS

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.

9. Documents Comprising the Tender

9.1 The tender to be prepared by the tenderer shall comprise:-

- i. The form of tender and appendix thereto.
- ii. A tender security.
- iii. The priced Bill of Quantity and Schedule.
- iv. The information on eligibility and qualification.
- v. Any other materials required to be completed and submitted in accordance with the instructions to tenderers.

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).

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 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.

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.

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.

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.

- 103 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.
- 104 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.
- 105 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.

11. Currencies of Tender and Payment

- 11.1 Tenders shall be priced in Kenya Shillings and the tender sum shall be in Kenya Shillings.
- 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 ruling on the date thirty (30) days before the final date for the submission of tenders.
- 11.4 Tenderers must enclose with their tenders, a brief justification of the foreign currency requirements stated in their tenders.

12. Tender Validity

- 12.1 The tender shall remain valid and open for acceptance for a period of ninety (90) 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.

13. Tender Security

13.1 The tenderer shall furnish as part of his tender, a Tender Security in the amount and form stated in the Appendix to Instructions to Tenderers.

13.2 The tender security shall be 2 percent of the total tender price.

13.3 The tender security shall be valid for at least thirty (30) days beyond the tender validity period.

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.

13.4 Any tender not accompanied by an acceptable Tender Surety will be rejected by the Employer as non-responsive.

13.5 The Tender Sureties of unsuccessful tenderers will be returned as promptly as possible 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.

13.6 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
 - (i) to sign the Agreement, or
 - (ii) to furnish the necessary Performance Security
- (c) if a tenderer does not accept the correction of his tender price pursuant to clause 23.

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.

Only one tender may be submitted by each tenderer either by himself or as partner in a joint venture.

14.2 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.

Any tenderer who fails to comply with this clause will be disqualified.

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 meeting will not be cause for disqualification of a bidder.

16. Format and Signing of Tenders

- 16.1 The tenderer shall prepare his tender as outlined in clause 9 above and mark appropriately one set "ORIGINAL" and the other "COPY".
- 16.2 The copy of the tender and Bills of Quantities shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the tenderer. All pages of the tender where amendments have been made shall be initialed by the person or persons signing the tender.
- 16.3 The complete tender shall be without alterations, interlineations or erasures, 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.

SUBMISSION OF TENDERS

17. Sealing and Marking of Tenders

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

- 172 The inner and outer envelopes shall be addressed to the Employer at the address stated in the Appendix to Instructions to Tenderers and bear the name and identification of the Contract stated in the said Appendix with a warning not to open before the date and time for opening of tenders stated in the said Appendix.
- 173 The inner envelopes shall each indicated the name and address of the tenderer to enable the tender to be returned unopened in case it is declared “late”, while the outer envelope shall bear no mark indicating the identity of the tenderer.
- 174 If the outer envelope is not sealed and marked as instructed above, the Employer will assume no responsibility for the misplacement or premature opening of the tender. A tender opened prematurely for this cause will be rejected by the Employer and returned to the tenderer.

18 Deadline for Submission of Tenders

- 18.1 Tenders must be received by the Employer at the address specified in clause 17.2 and on the date and time specified in the Letter of Invitation, subject to the provisions of clause 7.4, 18.2 and 18.3.

Tenders delivered by hand must be placed in the “tender box” provided in the office of the Employer.

Proof of posting will not be accepted as proof of delivery and any tender delivered after the above stipulated time, from whatever cause arising will not be considered.

- 18.2 The Employer may, at his discretion, extend the deadline for the submission of tenders through the issue of an Addendum in accordance with clause 7, in which case all rights and obligations of the Employer and the tenderers previously subject to the original deadline shall thereafter be subject to the new deadline as extended.
- 18.3 Any tender received by the Employer after the prescribed deadline for submission of tender will be returned unopened to the tenderer.

19 Modification and Withdrawal of Tenders

- 19.1 The tenderer may modify or withdraw his tender after tender submission, provided that written notice of the modification or withdrawal is received by the Employer prior to prescribed deadline for submission of tenders.
- 19.2 The tenderer’s modification or withdrawal notice shall be prepared, sealed, marked and dispatched in accordance with the provisions for the submission of tenders, with the inner and outer envelopes additionally marked “MODIFICATION” or “WITHDRAWAL” as appropriate.
- 19.2 No tender may be modified subsequent to the deadline for submission of tenders.
- 19.3 No tender may be withdrawn in the interval between the deadline for submission of tenders and the period of tender validity specified on the tender form. Withdrawal of a tender during this interval will result in the forfeiture of the Tender Surety.

- 19.4 Subsequent to the expiration of the period of tender validity prescribed by the Employer, and the tenderer having not been notified by the Employer of the award of the Contract or the tenderer does not intend to conform with the request of the Employer to extend the prior of tender validity, the tenderer may withdraw his tender without risk of forfeiture of the Tender Surety.

TENDER OPENING AND EVALUATION

20 Tender Opening

- 20.1 The Employer will open the tenders in the presence of the tenderers' representatives who choose to attend at the time and location indicated in the Letter of Invitation to Tender. The tenderers' representatives who are present shall sign a register evidencing their attendance.
- 20.2 Tenders for which an acceptable notice of withdrawal has been submitted, pursuant to clause 19, will not be opened. The Employer will examine the tenders to determine whether they are complete, whether the requisite Tender Sureties have been furnished, whether the documents have been properly signed and whether the tenders are generally in order.
- 20.3 At the tender opening, the Employer will announce the tenderer's names, total tender price, tender price modifications and tender withdrawals, if any, the presence of the requisite Tender Surety and such other details as the Employer, at his discretion, may consider appropriate. No tender shall be rejected at the tender opening except for late tenders.
- 20.4 The Employer shall prepare a tender opening register and minutes of the tender opening including the information disclosed to those present.
- 20.5 Tenders not opened and read out a tender opening shall not be considered further for evaluation, irrespective of the circumstances.

21 Process to be Confidential

- 21.1 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.
- 21.2 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.

22 Clarification Tenders

- 22.1 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.

- 22.2 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.

23 Determination of Responsiveness

- 23.1 Prior to the detailed evaluation of tenders, the Employer will determine whether each tender is substantially responsive to the requirements of the tender documents.
- 23.2 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.
- 23.3 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.
- 23.4 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.

24 Correction of Errors

Tenders determined to be substantially responsive shall be checked by the Employer for any arithmetic errors in the computations and summations. **Errors will NOT be corrected by the Employer.**

25 Conversion to Single Currency

- 25.1 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 twenty one (21) days before the final date for the submission of tenders.
- 25.2 The Employer will convert the amounts in various currencies in which the tender is payable (excluding provisional sums but including Dayworks where priced competitively) to Kenya Shillings at the selling rates stated in clause 25.1.

26 Evaluation and Comparison of Tenders

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

- 26.2 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.
- 26.3 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.
- 26.4 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.
- 26.5 Firms incorporated in Kenya where indigenous Kenyans own 51% or more of the share capital shall be allowed a 10% 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.
- 26.6 The tender evaluation committee shall evaluate the tender within 30 days of the validity period from the date of opening the tender.
- 26.7 Persons not officially involved in the evaluation of tender shall not attempt in any way to influence the evaluation.
27. Preference where allowed in the evaluation of tenders shall not exceed 15%

AWARD OF CONTRACT

28 Award criteria

- 28.1 Subject to clause 27.2, the Employer will award the Contract to the tenderer whose tender is determined to be substantially responsive to the tender documents and who has offered the lowest evaluated tender price subject to possessing the capability and resources to effectively carry out the Contract Works.
- 28.2 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. Notification of Award and signing of contract

- 29.1 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.

- 292 Upon the furnishing of a Performance Security by the successful tenderer, the unsuccessful tenderers will promptly be notified that their tenders have been unsuccessful.
- 293 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.
- 294 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.
- 295 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.
- 296 A tenderer who gives false information in the tender document about his 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.

30. Performance Guarantee

- 30.1 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.
- 30.2 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 (based upon the exchange rates determined in accordance with clause 35.4 of the Conditions of Contract) and a 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.
- 30.3 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.

31. Advance Payment

An advance payment, if approved by the Employer, shall be made under the Contract, if requested by the Contractor, in accordance with clause 33.1 of 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.

31. Corrupt and fraudulent practices.

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.

SECTION III

APPENDIX TO INSTRUCTIONS TO TENDERERS

| INSTRUCTIONS TO TENDERERS REFERENCE | PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERERS |
|-------------------------------------|---|
| 1.1 | The employer is the Vice Chancellor , Jaramogi Oginga Odinga University of Science and Technology. |
| 1.7 | Qualification criteria as set out in the tender evaluation criteria |
| 1.8 | N/A |
| 1.9 | Joint venture or individual tenderers only. |
| 1.13 | N/A |
| 2.3 | Or through email address: proc@joooust.ac.ke |
| 3.2.(e) | N/A |
| 3.4 | N/A |
| 3.6 | Validity period of 90 days |
| 3.8 | Tender surety shall be valid for 30 days beyond the validity of tender from the date of tender opening. |
| 3.12 (b) | N/A |
| 3.14 | One original and a copy of the original |
| 3.18 | Bid security of 2% OF THE TENDER SUM from a reputable bank recognized by the Central Bank of Kenya |
| 5.2 | Alternative bids not allowed |
| 5.7 | N/A: PPAD 2015 Applies |
| 5.9 | N/A |
| 5.12 | N/A |
| 6.5 | Successful tenderer to provide performance security of 10% of the Sub-Contract sum from reputable bank recognized by Central Bank of Kenya prior to Sub-Contract signing. |
| 6.8 | N/A |
| 6.12 | -The word “valuation” should read “variation” -Variation shall apply as prescribed by the Public Procurement and Asset Disposal Act, 2015 |
| 6.13 | Shall be 60 days from the date of receipt of the request |
| 8.0 | Due diligence shall be conducted before award in accordance with the Public Procurement and Asset Disposal Act, 2015 |
| 9.0 | Tenderer shall be required to provide litigation history which may be subjected to due diligence to ascertain the possibility of negatively affecting performance. |

SECTION IV

CONDITIONS OF CONTRACT (Including erection on site) 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.
- iii. Copies of the FIDIC Conditions of Contract can be obtained from:

FIDIC Secretariat
P.O.Box 86
1000 Lausanne 12
Switzerland

Fax: 41 21 653 5432
Telephone 41 21 653 5003

PREAMBLE TO GENERAL CONDITIONS

Commencement Date (Sub-clause 1.1.1.(I))

The date for commencement of the Works is _____ **SEPTEMBER 2020** _____

The Employer (Sub-clause 1.1.12.)

The Employer is **JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

The Engineer (Sub-clause 1.1.15)

The Engineer is _____

Time for Completion (Sub-clause 1.1.35.)

The Time for Completion is 12 months from the commencement Date.

Contractor's Profit (Sub-clause 1.6.)

The percentage to cover profit entitlement, where appropriate, is N/A %.

Ruling Language (Sub-clause 5.1.)

The version in **ENGLISH** language (ruling language) shall prevail.

Day to Day Communications (Sub-clause 5.2.)

The language for day to day communications is **ENGLISH** _____

Programme to be Furnished (Sub-clause 12.1.)

The Programme must be submitted in the form of _____ **MICROSOFT PROJECT** _____

Electricity, Water, Gas and Other Services (Sub-clause 14.3.)

Supplies on the Site are:

a. Electricity: _____ **KENYA POWER** _____

b. Water: _____ **SIAYA BONDO WATER AND SANITATION** _____

Employer's Equipment (Sub-clause 14.4.)

The following Employer's equipment is available for use by the Contractor under the Employer's operation: _____ **N/A** _____

Working Hours (Sub-clause 18.3.)

The normal working hours are 8.00AM-5.00PM
AS PER NEMA GUIDLINES

Delay in Completion (Sub-clause 27.1.)

Failure to meet the Time for Completion entitles the Employer to reduction in Contract Price as follows:

Amount per day_____N/A_____

Maximum N/A

Prolonged delay (Sub-clause 27.2.)

Maximum amount recoverable from the Contractor by the Employer:
N/A

Terms of Payment (Sub-clause 33.1.)

In addition to the provisions under Clause 33, the terms of payment shall be:

Payment in Foreign Currencies (Sub-clause 35.1.)

Payment in foreign currencies shall be arranged as follows:

N/A

Rates of Exchange (Sub-clause 53.3.)

The rates of exchange for the purpose of the Contract are:
N/A

Payment against Provisional Sums (Sub-clause 36.4. (b))

The percentage to be applied to Provisional Sums shall be _____%.

Maximum Liability (Sub-clause 42.2.)

The maximum liability of the Contractor to the Employer shall be N/A

Insurance of Works (Sub-clause 43.1)

The deductible limits in the insurance cover of the Works shall not exceed

Sub-clause 43.1. (a)

The additional risks to be insured are:

Third Party Liability (Sub-clause 43.3)

The amount of insurance against third party liability taken out by the Contractor shall not be less than:

Payment on Termination for Employer's Default (Sub-clause 46.3)

The additional amount payable by the Employer on termination shall not exceed:

Labour, Materials and Transport (Sub-clause 47.1.)

The method of calculating adjustments for changes in costs shall be:

Notices to Employer and Engineer (Sub-clause 49.2.)

The address of the Employer for notices is:

The address of the Engineer for notices is:

Applicable Law (Sub-clause 51.1.)

The applicable law is _____ law.

Procedural Law for Arbitration (Sub-clause 51.2)

The procedural law for arbitration is _____

Language and Place of Arbitration (Sub-clause 51.3)

The language of arbitration is _____ language.

The place of arbitration is _____

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.)

1.0 Conditions Precedent to Commencement (Sub-clause 1.1.1.)

The following financial and administrative requirements are conditions precedent to commencement.

2.0 Defects Liability Period (Sub-clause 1.1.11.)

The Defects Liability Period is _____ days.

3.0 Engineer's Duties (Sub-clause 2.1.)

The Engineer requires the consent of the Employer before exercising the following duties:

4.0 Operation and Maintenance Manuals (Sub-clause 6.6.)

Operation and Maintenance Manuals shall be in English language.

5.0 Manufacturing Drawings (Sub-clause 6.9.)

The Contractor is required to disclose to the Engineer or the Employer confidential information as follows:

6.0 General Obligations (Sub-clause 8.1.)

6.1 The following facilities will be provided by the Employer:

6.2 The facilities will be provided at the following rates:

7.0 Performance Security (Sub-clause 10.1)

The Contractor shall obtain a Performance Security of an amount Kshs.

8.0 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:

9.0 Price Variation

- 9.1** Contract price variations shall not be allowed for contracts not exceeding one year (12 months)
- 9.2** Where contract price variation is allowed, the variation shall not exceed 15% of the original contract price.
- 9.3** Price variation requests shall be processed by the procuring entity within 30 days of receiving the request.

10.0 Extension of Defects Liability Period (Sub-clause 30.4)

In the event of suspension the Defects Liability Period shall not last more than _____ days after the date the works would have been delivered but for the suspension.

11.0 Method of Application (Sub-clause 33.2)

Application for payment shall be made as follows:

12.0 Payment (Sub-clause 33.5.)

11.1 The period for payment shall be:

11.2 The place for payment shall be:

13.0 Delayed Payment (Sub-clause 33.6.)

The interest rate for delayed payment is simple interest at a rate three percentage points above the Central Bank of Kenya's average rate for base lending prevailing as of the first day the payment becomes over due.

14.0 Payment by measurement (Sub-clause 33.8)

The provisions for measurement are:

15.0 Customs and Import Duties (Sub-clause 48.1.)

The Contractor shall pay and be reimbursed by the Employer for the following customs, import duties and taxes in consequence of the importation of the Plant:

16.0 Arbitration (Sub-clause 50.2)

The rules of arbitration shall be those contained in the Arbitration Act of the Laws of Kenya.

SECTION V:

SPECIFICATIONS

Notes for preparing Specifications

1.0 Specifications must be drafted to present a clear and precise statement of the required standards of materials, and workmanship for tenderers to respond realistically and competitively to the requirements of the employer and ensure responsiveness of tenders. The Specifications should require that all materials, plant, and other supplies to be incorporated in the Works be new, unused, of the most recent or current models, and incorporating all recent improvements in design and materials unless provided otherwise in the Contract. Where the Contractor is responsible for the design of any part of the permanent Works, the extent of his obligations must be stated.

2.0 Specifications from previous similar projects are useful and it may not be necessary to re-write specifications for every works contract for universal application.

3.0 There are considerable advantages in standardizing **General Specifications** for repetitive Works in recognized public sectors, such as highways urban housing, irrigation and water supply. The General Specifications should cover all classes of workmanship, materials and equipment commonly involved in constructions, although not necessarily to be used in a particular works contract. Deletions or addenda should then adapt the General Specifications to the particular Works.

4.0 Care must be taken in drafting Specifications to ensure they are not restrictive. In the specifications of standards for materials, plant and workmanship, existing Kenya Standards should be used as much as possible, otherwise recognized international standards be used.

5.0 The Employer should decide whether technical solutions to specified parts of the Works are to be permitted. Alternatives are appropriate in cases where obvious (and potentially less costly) alternatives are possible to the technical solutions indicated in tender documents for certain elements of the Works, taking into consideration the comparative specialized advantage of potential tenderers.

The Employer should provide a description of the selected parts of the works with appropriate reference to Drawings, Specifications, Bills of Quantities, and Design or Performance criteria, stating that the alternative solutions shall be at least structurally and functionally equivalent to the basic design parameters and specifications.

Such alternative solutions shall be accompanied by all information necessary for a complete evaluation by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, proposed construction methodology, and other relevant details. Technical alternatives permitted in this manner shall be considered by the Employer each on its own merits and independently of whether the tenderer has priced the item as described in the Employer's design included with the tender documents.

PART A:

GENERAL SPECIFICATIONS

FOR ELECTRICAL INSTALLATIONS

PART A: GENERAL SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

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PART A:

GENERAL ELECTRICAL SPECIFICATION

1 GENERAL

This section specifies the general requirement for plant, equipment and materials forming part of the Sub-contract Works and shall apply except where specifically stated elsewhere in the Specification or on the Contract Drawings.

1.1 Quality of Materials

All plant, equipment and materials supplied as part of the Sub-contract Works shall be new and of first class commercial quality, shall be free from defects and imperfections and where indicated shall be of grades and classifications designated herein.

All products or materials not manufactured by the Sub-contractor shall be products of reputable manufacturers and so far as the provisions of the Specification is concerned shall be as if they had been manufactured by the Sub-contractor.

Materials and apparatus required for the complete installation as called for by the Specification and Contract Drawings shall be supplied by the Sub-contractor unless mention is made otherwise.

Materials and apparatus supplied by others for installation and connection by the Sub-contractor shall be carefully examined on receipt. Should any defects be noted, the Sub-contractor shall immediately notify the Engineer.

Defective equipment or that damaged in the course of installation or tests shall be replaced as required to the approval of the Engineer.

1.2 Regulations and Standards

The Sub-contract Works shall comply with the current editions of the following:

- a) The Kenya Government Regulations.
- b) The United Kingdom Institution of Electrical Engineers (IEE) Regulations for the Electrical Equipment of Buildings.
- a) The United Kingdom Chartered Institute of Building Services Engineers (CIBSE) Guides.
- d) British Standard and Codes of Practice as published by the British Standards Institution (BSI)
- e) The Local Council By-laws.
- f) The Electricity Supply Authority By-laws.
- g) Local Authority By-laws.
- h) The Kenya Building Code Regulations.
- i) The Kenya Bureau of Standards

1.03 Power Supply on Site

The supply voltage will be 240 volts single phase of 415 volts 3 phase 50 Hz. TN-S system, viz. separate neutral and protective conductor throughout the system.

2. INSTALLATION OF CABLES

2.01 General

Bending of cables shall be in accordance with table 52c of the IEE Regulations and no cable shall be bent to radius less than that specified by the cable manufacturers.

Cables shall be rated for the maximum connected load with due consideration to the following factors:-

- (i) Voltage drop not in excess of 4% of the nominal voltage.
- (ii) Ambient temperature.
- (iii) Degree of excess-current protection.
- (iv) Grouping.
- (v) Cables run under defined conditions.

2.02 Cables in conduits and Trunking

All cables shall be polyvinyl chloride (PVC) insulated to BS 6604, "PVC-insulated cables (non-armoured) for electric power lighting", 450/750 volt grade, unless an alternative is specified elsewhere in the contract documents. The quality and size of cables contained in any one conduit shall comply with IEE Regulation 529-7 and Appendix 12.

No cable with a cross-section area of less than 1.5mm² shall be used. All cables installed in a conduit or trunking system shall be PVC single insulated conductors and shall be colour coded in accordance with the IEE Regulation 524-3 and Table 52A.

Final sub-circuits shall be run in conduits separate from main or sub-main cables. All cables in conduit shall be drawn in simultaneously. All cables shall be drawn in without the use of excessive force, Without the use of lubricants and the wiring shall be easily withdrawable.

2.03 PVC/SWA/PVC Cable

These cables shall comprise copper conductors unless specifically detailed otherwise, laid up with PVC fillers bedded with an extruded inner PVC sheath, armoured with a single layer of galvanized steel wires, aluminium or strip as specified, and covered overall with PVC sheath.

Cables shall be manufactured to BS 6346 "PVC insulated cables for electrical supply" with conductor dimensions and resistances in accordance with BS 6360 1969, "copper conductors in insulated cables and cords", Armouring shall be galvanised steel to BS 1442.

Attention is drawn to Chapter 52 of the IEE Regulations and Appendix 9. Where the armour wires of cables are used to provide protective conductor they shall comply with the requirements of Chapter 54 of the IEE Regulations, particularly section 543; alternatively, additional cables with copper conductors shall be installed to reduce the impedance to a level which ensures compliance with Section 543 of the IEE Regulations.

Unless permission is given by the Engineer, no joints will be allowed. In the event of joints being authorized, they shall be made using plastic boxes of approved design filled with an approved cold pouring plastic or resin compound. The cable box shall incorporate suitable copper tapes and clamps to bond the armouring of the jointed cables.

The PVC/SWA/PVC cables should be terminated in the cable manufacture's approved glands. These shall be of the compression type providing controlled radial compression of the sheath seal. The gland shall incorporate an armour clamping ring and earthing ring and, where used outdoors, a lead washer shall be used to ensure a watertight joint between the gland and the unit to which it is fitted. The earthing ring shall be rigidly fixed to the item of equipment and terminated using brass nuts, bolts and washers. All gland terminations shall be protected by a PVC shroud which shall fit tightly over the cables.

The electrical Sub-Sub-Contractor is responsible for determining the true nature and extent of cable routes. No claim on the grounds of lack of knowledge will be entertained. All cable routes shall be agreed with the Engineer. After the cables have been installed and terminated, but prior to putting into service, they shall be subjected to an insulation test of 500 volts and the results of these tests (recorded on test sheets) forwarded to the Engineer.

3. CONDUIT AND CONDUIT FACILITIES - MILD STEEL CONDUIT SYSTEM

3.01 Conduits

Conduits shall be installed as required by the IEE Regulations and as detailed in this specification. All metal conduits must be heavy gauge, seam welded, steel tube screwed conduits manufactured to BS 31, "steel tube screwed conduits and fittings for electrical wiring", Class B, BS 4568, "Steel conduit and fittings with thread of ISO form for electrical installation", for metric conduit, unless specified otherwise. Conduits shall be finished black stove enamelled, except in positions exposed to water (other than water used in construction), steam condensation or the action of weather, where hot galvanised conduits shall be used.

Any conduits work rejected by the Engineer shall be replaced at no extra cost. No conduit smaller than 20 mm in diameter or longer than 50mm diameter shall be used.

All bends in conduit shall be in accordance with the IEE Regulation 529-5, and made in a conduit bending machine fitted with a former of the correct radius for each conduit size.

Conduits shall be secured in an efficient pipe vice whilst being screwed. Conduit system shall be installed so as to ensure compliance with requirements of IEE Regulations 529-7. Attention is drawn to Appendix 12 of the IEE Regulations.

3.02 Conduit Fittings

Conduit fittings shall have same finish as the conduits being used and shall comply with BS 31 or BS 4586. All conduit fittings shall be screwed or loop-in malleable iron circular type, fitted with covers secured by brass screws. Rectangular adaptable steel boxes may be used on multi-conduit runs.

All circular type boxes must be fitted with long screwed spout conduit entries with the screwed thread terminating within the spout and the edges of the internal orifice of the box rounded and smoothed to act as a bush except for the adaptable steel rectangular boxes and loop-in conduit boxes, in which case male bush and coupling must be used for conduit connections. In concealed installation, boxes shall be fixed with the rims flush with the finished surface, but when, for any reason whatsoever, the rims are below the surface, suitable extension rings of the required depth shall be provided and installed to finish flush with the surrounding surfaces and with the lids of sufficient oversize (7.5 mm minimum all round) to cover the junction between box and plaster. In no case will the use of site-manufactured bends, sets, elbows, inspection elbows or tees be permitted.

3.03 Fixing of Conduits

All conduits must be firmly and rigidly fixed to be entirely without whip or movement. Space-bar saddles, or strap saddles, must be used on the timbers in roof spaces and will be allowed when the conduits are run on the underside of exposed unsealed floor or ceiling joints. Pipe hooks or crumpets will not be allowed except for security conduits in chases, or screeds, when the top of the hook must at least be 10 mm below the finished surface of the wall, or 25 mm below the floor finish. Pipe hooks shall be galvanised.

The finish of the saddles must in all cases conform to the finish of the supported conduits. Galvanised, sherardised or cadmium plated screws shall be used in all cases where galvanised conduits are installed.

The standard cast iron distance saddle, (single fixing base and two-screw fixing top), must be used for all conduits run on the surface of walls and ceilings etc., fixed at intervals of not more than 1.2 metres.

3.04 Conduit Runs and Concealment

The routes of the conduit installation shall be agreed with the Engineer prior to commencing the installation. Conduits shall be installed at least 150 mm from, and preferably under, any hot water pipes and at least 50 mm from other surface pipes and cables. Conduits shall be bonded to other surfaces in accordance with the requirements of IEE Regulations 413-2 and 547-4 to 547-7 inclusive.

Each continuity test shall be applied to the system before plastering, screeding, or casting of concrete is commenced. Surface work will be allowed where certain pre-fabricated methods of construction preclude the concealment of the runs, and or fair-faced brickwork or block work or other unplastered walls.

Conduit runs shall be planned to obviate the need for draw-in boxes, but where the use of such boxes is unavoidable they shall be accessible at all times and be fitted with covers. When Conduits are specified as being installed on the surface the runs must be arranged to render the whole system as neat and inconspicuous as possible, having regard to the existing architectural features. All vertical and horizontal runs must be taken where conduits converge and run together near distribution centres to obtain a symmetrical layout. The distance between the conduits shall be maintained through bends and sets and shall not vary noticeably.

3.05 Flexible Metallic Conduit

Flexible Conduit shall comply with the BS 731 part 1. "Flexible steel conduit and adaptors for the protection of electrical cables." It shall be used for the final connection from a rigid conduit installation to the terminal boxes of all the equipment provided with a means of positional adjustment and /or where vibration may reasonably be expected to occur.

Flexible conduits shall be PVC sheathed and shall be terminated using approved glands. In all instances a separate PVC insulated green and yellow coloured protective conductor complying with table 41A1 or 41A2 and section 543 of the IEE Regulations shall be installed, terminating at each end into purpose-made earthing terminals.

Under no circumstances will flexible conduits be accepted in lieu of sets and bends in a rigid conduit installation.

In normal circumstances flexible conduits shall have a minimum length of 300 mm and a maximum unstretched length of 800mm. It shall permit a full range of withdrawal, adjustment or movement of the equipment.

3.06 Locking, Bushing and Coupling

All conduit ends must be filed square and reamed before erection to ensure freedom from internal burrs and roughness.

Running couplings shall only be used on black enamelled steel conduit installations, and the use of this shall be kept to the minimum. All running couplings shall be secured by means of the lock nuts or lock rings, and the exposed thread painted after installation.

Every conduit connection to the equipment, boxes, distribution boards, loop-in boxes, cable trunking etc, shall be made by means of a screw coupling and a male hexagonal headed smooth bore brass bush. The smooth bore shall be fitted to secure the conduit to the item connected via a purpose-made clear hole to be closed by the bush and coupling when fitted. Paint must be removed from the surface of the item connected to allow it to be covered by the end of the coupling which shall be filed, clean and square, to ensure a good mechanical and electrical metal to metal joint. Any exposed area of metal from which paint has been removed must be made good in a matching paint. Bushes shall be fitted and tightened by means of correctly fitting spanners. Mutilated bushes damaged whilst being fitted must be removed and replaced.

Conduits connecting via couplings shall be connected by a means of 15 mm long threaded section and shall have a gap of approximately 2 mm between them. No thread shall be exposed except running couplings.

3.07 Continuity and Earthing

The whole of the conduit installations shall be mechanically and electrically sound and continuous throughout their length in accordance with the IEE Regulations.

Where the conduit system is used to provide a protective conductor it shall comply with the requirements of Chapter 54 of the IEE Regulations particularly Section 543; alternatively, a separate protective conductor shall be installed in the conduit to comply with Section 543 of the IEE regulations.

4. CABLE TRUNKING-SHEET STEEL

Trunking shall only be installed in situations which will remain readily accessible throughout the life of the buildings. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

All cable trunking shall comply with BS 4678, part 1 "Steel surface trunking" and part 2 for "Steel underfloor (duct) trunking".

Sheet steel cable trunking may be used on installations employing steel conduits, for connecting two or more switchboards together or where several conduits would otherwise have to run alongside each other. Proper allowance should be made for the derating of cables installed together in a container system. The cables must be capable of carrying the current imposed by the equipment connected. Attention is drawn to Chapter 52 of the IEE Regulations, particularly Section 522, and Appendix 9: the current carrying capabilities of cables indicated shall not be exceeded. The Engineer must be consulted as to precise details concerning trunking routes and applications.

All lengths of trunking shall be heavy gauge zinc coated steel connected together by internally fitted rectangular couplings of sufficient width to provide a minimum bearing face of 25mm, to which the lengths shall be bolted on site or welded at the factory.

Adequate provision shall be made to allow for expansion.

All Tee pieces and bends shall be formed with similar means of connection and the inner radii area shall be such that cables will not be bent through a radius less than that prescribed in the IEE Regulations. Only bends and tees of approved pattern will be accepted.

All fixing screws within the trunking shall be of the round head type. The trunking shall have an over-lapping well-fitted lid securely fixed to the trunking by approved means that will avoid damage to the cables. Self-tapping screws shall not be used.

All necessary accessories including long sleeve couplings, end piece, bends, sets, tees, reducers, branches, fillets, pinracks, cable retainers etc., shall be purpose-made units rather than being fabricated on site.

Where a change in direction of trunking run occurs, the deviation should be effected by a purpose-made unit manufactured on similar lines to the bends and tee pieces described above. Where this is not practical, changes in direction shall be fabricated in a neat workmanlike manner. All joints shall fit closely and gaps will not be permitted. All burrs and sharp edges shall be removed and no screw shall protrude into the trunking.

Trunking shall be firmly attached to its associated equipment either by bolted flanges or by male bushes and couplings.

Where trunking is connected to equipment by means of flange connectors, the entry into the equipment shall be of the same cross-section as the trunking.

Where trunking does not terminate in equipment, the otherwise open end shall be capped with a cover suitable bolted in position.

Where communications, extra low voltage circuits (category 1) etc., are contained in a trunking, the requisite number of separate compartments shall be provided to segregate the wiring. Where conduits are taken off such trunking they shall not pass through other compartments unless prior permission is obtained from the Engineer.

The entire trunking is required to be recessed in the structure of the building, the finished edge of the trunking is to be installed flush with the plasterwork.

Trunking runs shall be so arranged that the lid or cover plate is always on the top or side and not underneath, unless this cannot be avoided, in which case the Engineer's permission shall be obtained.

Wherever trunking passes through walls, vertical partitions etc., a fixed piece of trunking lid shall be fitted to the trunking extended 25 mm either side of the wall or other barrier, this is to allow removal of the adjacent lid without disturbing the building fabric. Care shall be taken to ensure that no opening is left between the trunking and the building structure through which fire might spread. In addition a suitable barrier of incombustible material shall be provide and fitted inside the trunking, in accordance with the IEE Regulations 528-1. On vertical runs of trunking internal incombustible barriers shall be fitted at the distance between floors or 5m, whichever is the less, in accordance with IEE Regulations 523-6.

All necessary trunking support work, hangers, brackets and fixing requirements shall be provided by the electrical Sub-Sub-Contractor.

Earth links of the appropriate size and type shall be installed at every jointing coupling, manufactured bend, etc., throughout the entire trunking system. Where trunking is used to provide a protective conductor it shall comply with the requirements of Chapter 54 of the IEE Regulations, particularly Section 543; alternatively, a separate protective conductor shall be installed in the trunking to comply with section 543 of the IEE Regulations.

In cases where sheet steel trunking is installed and there is danger of movement, a flexible earth conductor shall be installed bonding all joints in the trunking. This shall be fitted in addition to the standard earth links. Cable retaining strips shall be fitted at 1 m intervals. Insulated cable support pins shall be fitted at intervals of 4 m in vertical runs of trunking and at the top of the vertical trunking.

5 CABLE TRAYS

Cable trays shall be formed from perforated steel of not less than 0.9 mm thickness up to and including 100 mm width - 1.25 mm thickness from 150 mm up to and including 300 mm width - and 2.00 mm thickness above 300 mm width. They shall be galvanised unless otherwise specified. Tray shall be adequately sized to support the cable without bunching.

Support shall be by means of steel brackets installed at intervals necessary to provide a rigid fixing and ensure that no undue deflection occurs in the complete installation. The brackets shall be galvanised prior to fixing. Dome-headed bolts, nuts and washers of finish suitable to the tray shall be used between tray and brackets.

Fixing to the surfaces of walls, ceilings, etc. shall be by means of expansion-type masonry plugs or bolts. Fixings shall be galvanised unless otherwise stated. Cable trays shall be installed using factory-formed bends, elbows, tees, couplers and risers etc. Site fabrication of elbows etc., will only be permitted with prior approval of the Engineer and where it is not possible to obtain the necessary factory-made item.

Where cuts have been made, the tray shall be painted with zinc rich paint.

Holes which have been cut to allow cables to pass through shall be suitably bushed.

Suspension sets shall comprise threaded M12 cadmium plated hanger rods together with nuts and locking washers, vertical hanger brackets, support channel, tray hold-down clips etc., all of which shall have a galvanised finish.

All cables shall be securely fixed to traywork and the complete installation must be carried out in a neat and workmanlike manner without crossovers. A 25% reserve margin in size and weight shall be allowed for all cable tray works.

Cables of 30 mm diameter and above shall be fixed using the appropriate size cable straps of approved manufacture.

On light duty multi-cable runs, cable straps of plastic coated metal shall be used to secure cables.

Bunching of cables will not be permitted.

Cables shall be clipped by means of copper or brass saddles and clips where high temperature or humid conditions are likely to be experienced. In all cases, saddles, clips, straps, etc., shall be fixed to the tray by means of brass screws or bolts and nuts.

6. PROTECTION OF PVC/SWA/PVC CABLES

6.01 General

Cable routing shall be such that the maximum degree of protection against accidental damage is obtained by running cables along the inside of channels and beams, etc.

Cables shall be laid in performed trenches or duct throughout all paved areas. Ducts shall be installed for underground cables before the paving is constructed.

Cable ducts shall be sealed at both ends using materials which are resistant to any likely corrosive and insect attack in the area concerned.

All cables rising through floors and trench covers, except in switch rooms, shall be protected by a length of steel pipe which shall project at least 150 mm above the finished surface level.

The open end of the pipe shall be sealed with a suitable compound. Care must be taken that all phases of single core cables pass through the same protective steel duct.

6.02 Cables Direct in Ground

All excavation and backfilling of cable trenches will be carried out by the main Sub-Contractor unless otherwise specified, but the electrical Sub-Sub-Contractor shall in any case make sure that trenches are made to a depth as specified.

The electrical Sub-Sub-Contractor shall lay cables direct in the ground in the following manner:-

75 mm (3 inches) of dry fine sand shall be placed to form a bed for the cables. After cables have been laid they shall be covered with additional dry fine sand well punned over and around the cables to a level of 75 mm above the top of the uppermost cable. Mechanical punners shall not be used for this work. The electrical Sub-Sub-Contractor shall supply and install concrete cable tiles which shall be carefully placed over the cable forming each circuit.

Until all the cables have been laid in the trench and have been covered with their protective tiles, no sharp metal tools such as spades or fencing stakes, shall be used in the trench. Rollers used during laying of cables shall have no sharp projecting parts liable to damage the cables.

6.03 Cables above Ground

For main cable runs the cable shall be run on approved tray or ladder rack, and secured to it at intervals of not more than 400 mm horizontally and 600 mm vertically.

Cables shall be dressed together and fixed with a common saddle. If the number of cables is such as to require the tiering of cables, the number of tiers shall generally be two.

7 TERMINATION OF CABLES

Cables shall be terminated in accordance with Chapter 52 of the IEE Regulations, particularly Section 527.

Cables shall be terminated by one of the following methods:-

- (i) The cable conductors shall be sweated into lugs of the appropriate size for the cable and equipment terminal.
- (ii) The cable conductors shall be secured by compression type lugs of the correct size for the cable and equipment terminal.
- (iii) The cable conductors shall be secured in pinch screw terminals.
- (iv) The cable shall be secured by means of clamps.

Where cables are required to terminate at connectors, as at lighting points, such connectors shall secure all the strands of stranded cables. Care shall be taken to ensure that cables are not damaged during preparation for termination.

Cables terminating at pinch screw terminals shall be twisted together and single cables shall have the conductor doubled back to ensure adequate purchase for pinching screws.

Cables connected to lamp holders or other components at which heat is produced shall be insulated with heat resisting material capable of withstanding, without detriment, the temperature encountered.

All terminations on PVC/SWA/PVC insulated cables shall be by compression type glands of an approved design and manufacture with facilities for clamping the armouring the outer sheath of the cable.

Glands mounted outdoors shall incorporate a seal to prevent ingress of moisture into the gland, and all glands shall be fitted with a thermoplastic shroud.

Where circular terminations are to be made, these shall be completed using Ross Counterney terminals.

Where cables are terminated in "Klippon" type terminals with parallel faced jaws, the individual cores shall be terminated using the appropriate flat or hook blade crimped lugs. Where the terminal faces are concaved, the cores shall be terminated in wires pin crimped lugs.

The electrical Sub-Sub-Contractor shall avoid multiple connections under one screw or one pin. Where more than two wires are required, a common termination jumper bar shall be used.

Terminals shall be mounted on rails or supports. All internal wiring is to be clearly marked by markers.

8 SEGREGATION OF SERVICES

Cables of differing voltages shall be segregated so that there is no possibility of a fault in a power cable damaging any adjacent cables or imposing a different voltage upon them.

9 IDENTIFICATION OF CABLES

All cables shall be fitted with non-corrosive cable identification bands at each end, and at all changes of direction where they leave a group of cables. All cables cores connected to equipment having marked terminals shall be fitted with non-corrosive identification bands bearing markings corresponding to those of the terminals at both ends.

10. EARTHING

The whole of the metallic portion of the installation, other than current carrying parts, shall be electrically and mechanically bonded to the consumer's main earth terminal and also if applicable, to the lighting protection system or other points specified.

The installation shall be earthed in accordance with the Sixteenth Edition of the Regulations for Electrical Installation issued by the IEE, BS CP1013, "Earthing" and BS 6651 "The protection of structures against Lightning". The electrical Sub-Sub-Contractor's attention is drawn to Chapter 54 of the IEE Regulations.

A main earth terminal shall be supplied and installed adjacent to the electricity supply cable termination. The terminal shall be of ample size and capacity to suit the installation. All items of equipment, switchgear, etc., shall be bonded to this earth terminal using PVC insulated PVC sheathed cables, coloured green and yellow and sized in accordance with Tables 41A1 of the IEE Regulations. An invoice label reading **"SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE"** in engraved upper case characters not less than 4.75mm high, shall be permanently fixed immediately adjacent to or on the earth terminal.

A heavy duty copper clamp complying with BS. 951 shall be used to bond the main protective conductor to the electricity supply cable armouring or metallic sheath (where applicable the armouring and sheath shall be bonded together).

All protective conductors shall, where possible, be enclosed within metal trunking or conduit serving switchgear, distribution board etc., so as to provide mechanical protection. Where protective conductors are run on building surfaces they shall be properly fixed and supported by means of PVC coated metal saddles along selected routes.

Earth continuity between separate items of switchgear, distribution boards etc., mounted adjacent to one another shall be affected by means of high conductivity continuous copper tape, or PVC sheathed cable, coloured green and yellow, and sized in accordance with the Table 41A1 or 41A2 and Section 543 of the IEE Regulations, connecting all items to the earth terminal.

All items of switchgear, accessories, luminaries, conduits, and the outer sheaths of MICS cables, the armouring of all PVC/SWA/PVC cables together with all other items of electrical plant and equipment shall be effectively earthed by means of a protective conductor in accordance with Table 41A1 and 41A2 and section 543 of the IEE Regulations.

At every terminal point on the fixed wiring an integral earth terminal shall be provided e.g. BESA boxes, accessory boxes etc. A protective conductor shall be provided and installed between this terminal and the earth terminal on the associated switch, socket outlet, luminaire etc.

Each circuit protective conductor shall be connected to a multi-way earth terminal provided and fixed within each distribution board. The earth terminal shall be provided with an adequate number of ways such that not more than one conductor per terminal shall be installed and the earthing conductors shall be connected in the same sequence as the current carrying conductors.

All metal piped services, e.g., Heating, Water and Gas Services, metal wastes and piped services at sinks, baths and showers etc., shall be bonded to the earth terminal in accordance with the IEE Regulations 413-2.

A 50mm section of each gas and water pipe, at position close to their entry into the relevant building, shall be cleaned and made smooth. A copper earthing clamp designed to permit the connection of protective conductors shall be provided and sized in accordance with Table 41A1 and 41A2 and Section 543 of the IEE Regulations.

The clamp shall be a proprietary type or shall be fabricated from high conductivity copper strip, minimum size 40 mm x 4 mm which shall encircle the cleaned sections of the pipe. A permanent label indelibly marked with the words, "**SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE**" in legible type not less than 4.75 mm high, shall be permanently fixed at the points of connections.

The final connection of bonding conductors from gas, water pipes and other services to the earthing terminal shall not be completed until earth electrode and earth impedance tests have been satisfactorily completed.

Bonding connections to pipework shall be as unobstructive as possible where practicable shall be made in service ducts or accessible voids and shall be readily on the Record Drawings. All materials and sundry item shall be provided whether or not specifically mentioned, necessary to completely and effectively earth the installation. The installation shall be fully protected against dampness and corrosion and the effect of electrolytic action between dissimilar materials. A completely permanent installation shall be provided which shall be fully accessible for regular testing and inspection.

The value of earth resistance from any point of an installation to the general mass of earth shall be low enough to ensure operation of circuit protective devices and shall in any case not exceed four(4) ohms for electrical equipment, seven (7) ohms for lighting protection. Each earthing cable shall terminate in an approved design of cable lug.

Where earth conductors are run upon structures or walls they shall be fastened by means of heavy gauge non-ferrous fasteners not more than 0.75 m apart on horizontal runs and not more than 1.2 m apart on vertical runs and to give a minimum clearance of 4 mm from the fixing face.

In the event of the electrical sub-Sub-Contractor not being able to establish a suitable earth connection to the electricity supply cable, earth electrodes shall be installed which shall be galvanised or copper clad steel extendable rods not less than 16 mm diameter and not less than 1.2 m in length. Connections to electrodes shall be made by means of solderless mechanical clamps.

To avoid corrosion, all earth system connections shall be cleaned bright and immediately covered with silicon MS4 compound or approved equal.

Earth pits, where required, shall be in accordance with the Sub-Contractor's relevant drawings, with the facility to disconnect the earth ring while measuring the electrode earth resistance.

11 LIGHTNING PROTECTION

Lighting protection shall be provided on high buildings/structures more than 10 m in height. such protection shall be effected by bonding each individual building/structures direct to the earthing system, in accordance with the BS CP 326, by a minimum size of 170mm² conductor.

12 FUSED-SWITCH UNITS, SWITCHFUSES AND ISOLATORS

The above units comply with BS 5419 and shall be 500 volt type and installed where specified and indicated on the relevant drawings.

All switchgear shall be provided with suitable locks for padlocking the switches in the 'OFF' position. The cover shall be interlocked with the operating mechanism to prevent it from being opened in the 'ON' position. This interlocking shall also prevent the switch from being closed with the cover open unless for maintenance purposes. The cover shall be gasketed to prevent ingress of dust.

The switch action mechanism shall be of the parallel operation (double break type having cartridge fuses mounted switches) and shall be ASTA certified to meet adequately all the duties specified.

The end plates shall be removable for drilling for conduit or cable entry and shall be fitted with additional distance pieces where necessary. Switchgear boards shall be fixed to the wall/floor by Rawl bolts or other approved fixings.

No building alteration shall be allowed when moving the switchboard into position, the switchboard being supplied in sections to be built in position, if so required.

Switchgear shall be delivered to site when required to suit the progress of the works. Care shall be taken to preserve the manufacturer's paint finish. Any refurbishing etc. shall be carried out, using paint obtained from the switchboard manufacturer, to the original standard of finish.

All fuses in switchgear shall be HRC fuses sized for the fused-switch units or switch-fuses etc., in which they are incorporated. They shall be ASTA certified for compliance with BS 88, Category of Duty 440 A.C 5 Class 01 and in all cases fuse links shall be selected to provide circuits discrimination.

13 CONTROL PANELS AND CUBICLES

The details specified in clause 4.11 shall apply as far as fused switches, bus-bars and rating etc are concerned. The panels shall be constructed from rolled steel channel minimum size 60 mm x 30 mm deep x 5 mm or equivalent angle section clad with sheet steel of 3 mm gauge. 2 mm gauge may be used for covers and doors of not more than 1 m square.

Terminals shall be of the "Klippon" standards rail-mounted feed-through type or approved equal. All terminals shall be identified by means of numbered or lettered marking tags, which shall be identical to the number of letter applied to the cables. Cables shall be identified as terminations by means of cable markers as manufactured by "Klippon" or approved equal. 25% spare terminals capacity within wiring duct shall be provided. All components motors, starters, relays, timers, etc. shall be labelled showing their reference and function and these shall relate to the panels' schematic wiring diagram provided with the "As-built" drawing and manuals.

All control panels shall be fitted with multi-pole isolating switches through which all electricity supplies shall pass. The door(s) of the control panel shall not open unless the isolating switch is in the "off" position. A facility to lock the control panel-isolating switch in the "off" position shall be included.

14 DISTRIBUTION BOARDS

14.1 General

All distribution boards, unless stated otherwise, shall be miniature Circuit Breaker Distribution Boards and shall be of surface or flush type, as specified. Facilities for local isolation of the distribution boards shall be provided by either a local fused-switch unit or an integral isolating switch, whichever is specified.

Where surface mounted on a flush installation, all conductors shall terminate behind the board in an adequate box. For surface mounting, trunking shall be fixed between the board and ceiling level, or conduits run directly into the board. Adequate earth continuity connection shall be made between the various components.

14.2 Fused Distribution Boards

All fuse boards shall be of 500 volt rating to BS. 5486 part 11 "Particular requirements for Fuse boards". The details specified in clause 4.12 shall apply as far as cabinet and construction, cabling arrangements, bus bars, neutral bars, earthing and isolating switches are connected.

Fuse banks shall be spaced so as to obviate the necessity for insulating barriers, but protection shall be provided by means of insulating shields to prevent accidental contact with the main bus bars and connections.

All fuses lighting and heating circuits shall be of the HRC cartridge type, ASTA certified, for compliance with BS. 88, category of Duty 440 A.C 5 class 01.

14.3 Miniature Circuit-Breaker Distribution Boards

MCB distribution boards shall comply with BS. 5486 part 12 'Particular requirements for miniature circuits-breaker boards'. The cases shall be constructed of heavy gauge sheet steel, in such a manner as to afford rigidity and maximum ease of wiring for full size circuit and main cables.

The cover shall be provided with an efficient gasket or alternatively designed with generous overlapping edges to prevent the ingress of dust. Components shall not be manufactured from zinc alloy in conjunction with sheet steel where they are relied upon for earth continuity.

Where the cover is required to be lockable, cylinder type locks shall be provided, having two keys per lock. All locked distribution boards shall be handed to the Engineering Supervisor on completion of the works. The cases shall be provided with detachable cable/conduit terminating plates, which shall be reversible and interchangeable from top to bottom.

All screws and nuts used in the construction of the case shall be fitted with shake proof washers and care taken to ensure efficient earth continuity. An external earthing terminal with cable socket shall be fitted.

All MCB banks shall be fitted to frames, with robust locking plates provided to ensure the frames rigidly in the fixed position.

The banks shall be so spaced to obviate the necessity for insulating barriers, but protection shall be provided by means of insulating shields to prevent accidental contact with main bus bars and incoming mains cable.

Bus-bars shall be of high conductivity, hard drawn copper conductors connected to the MCB contacts by means of spring washered screws or bolts, unless plug-in type MCBs are specified.

Neutral bars shall be similar to the main bus bars and shall have two screw terminals per way for rating of 30 amps or over. Single screw connections will be allowed for capacities up to 30 amps. The neutral bars shall have one terminal for each MCB within the board, and connection of conductors to the neutral bar shall be in the same order as the MCB ways.

Where installations are carried out with cables with a protective conductor, all distribution boards shall also contain internal earthing bars similar to the neutral bars detailed above, with one terminal for each MCB within the board. Earthing conductors shall be connected in the manner described for neutral conductors to neutral bars.

Where a main integral isolating switch is provided in an MCB case it shall be arranged to isolate incoming live and neutral main cables from the bus-bars. The isolator switch shall be rated at 500 volts and of the quick make-and break pattern with positive action. Incoming and outgoing terminals shall be fitted with two clamping screws and outgoing conductors to the bus-bars shall be high conductivity hard drawn copper rods.

Isolating switches shall comply with IEE Regulations, Part 537, and shall be capable of carrying their full rated load continuously and shall 'make' or 'break' their full rated load without undue burning of the contacts.

14.4 Miniature Circuits Breaker (MCB)

All MCBs shall have movements which are positive in both directions (make and break) so as to enable units to be closed decisively by the operation of the handle, and to be able to assume the 'OFF' position unless the contacts are definitely separated, to safeguard against false indications.

The handle shall be trip free to make it impossible for the operator to hold the breaker in the closed position under faulty conditions. The operating mechanism and arc chambers of the circuit breaker shall be separated from the terminals and fixing screws.

Terminal identification shall be readily discernable as viewed from the front of the board with automatic and clear signal identification for both 'ON' and 'OFF' position.

All terminals shall be readily accessible from the front and each wiring chamber shall be closed by a screw fixed cover which protects the terminals and prevents dust from settling on the insulation.

Where the full capacity of a distribution board is not required the electrical Sub-Sub-Contractor shall fix blanking plates in the vacant MCB housings. All MCBs shall be rated at 500 volts minimum, and comply with BS 3871. "Miniature and moulded case circuits breakers" and 4752 part 1, "Circuit breakers".

14.5 Moulded Case Circuit Breakers (MCCB)

Where specified, MCCBs shall be of the thermal/magnetic type, having a quick make, quick break, trip free mechanism which prevents the MCCB from being closed or held against short circuits or overloads. Tripping of every multi-pole MCCB shall be such that operation ensures simultaneous action in all phases.

Clear indication shall be provided for the three positions of operation of the mechanism - 'ON', 'OFF' and 'TRIPPED'. The operation shall be such that the MCCB shall trip automatically under fault conditions and, to reset, the dolly shall require first moving through the 'off' position. All MCCBs shall be provided with facilities for locking the breaker in 'OFF' position.

All MCCBs shall be rated at 500 volts minimum, be ASTA certified for this operational duty, and comply with BS. 3871 and BS. 4752 Part 1.

15 LABELLING AND ENGRAVING

15.1 Labelling

All fused-switch units, switch-fuses, switches, bus-bars chambers, distribution boards etc., and all items of equipment on the main panel shall be identified in accordance with section 514 of the IEE Regulations and shall have securely fitted externally a white 'Traffolyte', 'Formica' or other approved plastic laminate label engraved with 6 mm high black letters detailing the function of the equipment and any reference number.

Red, yellow, blue, plastic laminate phase discs shall be fixed inside all switchgear and distribution boards to indicate to which phase of the supply the various circuits are connected. The colourings shall comply with Part 524 of the IEE Regulations.

Each TP or TP & N item of switchgear shall have fitted on the cover a white plastic laminate label having 'CAUTION' - 415 VOLTS' engraved in 10 mm high red lettering.

5.2 Engraving

The electrical Sub-Sub-Contractor shall allow for engraving of all switched fused spurs, double pole switch accessories and any other accessories, which are customarily required.

The accessory plate shall be engraved in either black or red, capital letters 5 mm high, detailing and appliance or equipment being supplied by the accessory e.g., 'WATER PUMP' etc.

16 MOUNTING HEIGHTS

The approximate position of main switchgear, control equipment distribution boards, fittings and accessories shall be as indicated on the Drawings. Actual positions shall be determined on site by the Engineer.

Unless otherwise stated on the relevant drawings or directed by the Engineer the following mounting heights of all accessories above finished floor level shall be adhered to: -

| | |
|------------------------|--|
| Lighting Switches | 1400 mm to centre |
| Socket Outlet and Spur | 300 mm to centre (or 150 mm above work top level to centre) |
| Distribution Boards | 1800 mm to lower edges. |

All groups of accessories shall be in line either vertically or horizontally or as specified.

17 LUMINAIRES

All Luminaires shall be of the manufacture, size and type specified and shall comply in all respects to BS 4533 "Electric Luminaires".

The electrical Sub-Contractor shall supply and install all luminaires including lamps, lamp-holders, control gear, capacitors, glassware, diffusers or other attachments, heat resistant internal cables, fuses and terminals and all necessary suspension gear. In case where Luminaires are supplied by the client the Sub-Sub-Contractor shall deliver to site store, install, commission and set to work.

Unless otherwise stated, Luminaires shall be suitable for Class 1 normal indoor environments, giving a degree of protection against ingress of moisture or dust.

All Luminaires shall be assembled and installed in accordance with the respective manufacturer's instructions/recommendations, in the position and mounting heights specified.

Luminaires shall not be installed under dirty and hazardous site conditions, and any damage or deterioration to luminaires installed under these conditions shall be made good by the electrical Sub-Sub-Contractor.

The Luminaires shall be cleaned free of dust and dirt after completion of the installation. Where dirt, dust, corrosion or other conditions cause imperfections in the luminaires, they shall be replaced.

Luminaires, diffusers, attachments or glassware etc., shall be properly stored to final erection, in such a manner as to avoid damage of any kind.

Luminaires fixings shall generally be suitable for direct connection to conduit boxes or as otherwise specified. Luminaires not provided with suitable BESA box shall be modified as necessary.

Where a flexible cord supports, or partly supports, a luminaire the maximum mass supported by the cord shall not exceed the values set out in IEE Regulations 523-32.

The minimum cross-section area flexible core to the employed shall be 0.75mm².

Specified attention shall be given to Chapter 52 of the IEE Regulations, particularly Regulation 521-5 and 521-6, Appendices 9 and 10.

Pendant tungsten luminaires shall be fitted with heat resistant flexible cord complying with BS 6500, capable of continuous operation with a conductor temperature of 150 degrees C. The cable shall be of the circular multicore type, finished white, if not otherwise specified.

Ceiling mounted tungsten luminaires, spotlights and other luminaires of the category 'hot' luminaires shall be wired internally with cable suitable for continuous operation at 185 degree C. Where cable tails are provided they shall be of the heat resistant type capable of operation at 185 degree C.

Exterior luminaires, fixed to the walls of buildings etc., shall be wired such that final circuit wiring terminates within the luminaire. All final circuit cables so installed shall be provided with heat resistant sleeves from the connection point within the luminaire for a distance of 300 mm.

All fluorescent and other discharge luminaires shall be provided with an integral fused connector block. The rating of the fuse shall be in accordance with the manufacturer's instructions to protect the internal wiring of the luminaire and to provide discrimination between final circuit protection and luminaire protection.

All recessed and semi-recessed luminaires in ceilings shall be connected by three core 0.75 mm² high temperature flexible cord from the terminals of the luminaires to a plug-in ceiling rose fixed and connected to an accessible outlet box in the wiring system, within the suspended ceiling immediately above the luminaire. The ceiling rose shall be accessible via the opening provided in the ceiling.

The electrical Sub-Sub-Contractor shall ensure that the methods of suspension for luminaires are electrically and mechanically sound.

Luminaires suspended by means of tubes shall be fitted to ball joints allowing a swing of at least 20 degrees all round. Reliable earthing between the fixed and moving parts shall be provided by means of a flexible braided copper tape.

Fluorescent luminaires shall be provided with a minimum of two fixings, except in the case of recessed modular luminaires or surface-mounted luminaires exceeding 300 mm in width, where four number fixings (one from each corner) shall be provided by means of conduit drops or threaded rods.

Normally visible luminaires support shall be conduit. All fluorescent luminaires shall be solidly mounted with all assembly nuts, bolts and accessories made tight to prevent vibrations and noise. Anti-vibration packing shall be fitted where necessary. luminaires mounted direct to trunking shall be fixed by means of the manufacturer's recommended fixing assemblies.

Unless stated otherwise, all luminaire supports shall be fixed to the building primary structure. Luminaires shall not be supported from suspended ceiling unless otherwise specified. The electrical Sub-Sub-Contractor shall be responsible for mounting and fixing arrangements.

Break joint rings of approved colour shall be provided for all suspended luminaires and fluorescent battery luminaires where the batten is of insufficient width to cover completely the conduit box and its associated clearance hole in the ceiling.

The metalwork of all luminaires shall be effectively bonded to the earthing system in accordance with Chapter 54 of the IEE Regulations.

Care shall be taken to ensure that the internal wiring of luminaires and the cable of any fixed wiring shall not be in contact with high temperature areas in luminaires.

Lighting track shall be of the type, size, finish, number of circuits and manufacture specified and shall comply with the requirements of the relevant section of BS. 4533. The positions of luminaires as shown on the Drawings are approximate only and exact position shall be determined after reference to the Engineering supervisor.

18. CEILING ROSES

Surface mounted ceiling roses shall be of all insulated, high impact moulded plastic construction complying with BS. 67 and shall be suitable for direct attachment to conduit outlet boxes. Recessed or semi-recessed ceiling roses shall be manufactured from porcelain. Break joint rings shall be provided when used on flush conduit outlet boxes.

Ceiling roses shall not be connected to fixed wiring in such a manner that one of the terminals remains 'live' when the associated switch is in the 'off' position, unless that terminal is inaccessible to touch when the ceiling rose cover is removed, e.g. for replacement flexible cord.

Terminals shall be provided for switched live, neutral and protective conductors. Loop-in facilities shall also be provided.

19 LAMPS

Lamps shall be compatible with the luminaire for which they are intended and shall be of the wattage, type and colour specified. Lamps shall be of the correct voltage rating for the particular electricity supply concerned.

Tungsten filament lamps, unless otherwise specified, shall be of the 'PEARL' type and of the long-life type giving 2000 hours average life.

Luminaires designed to accommodate lamps with reduced physical dimensions shall be fitted with lamps of the mushroom type of approved equal.

20 EXTERNAL LIGHTING

External lighting system shall comprise the lighting points at the position shown on the Drawings and shall include the provision, erection and connection of all lighting columns, bollards, wall and ceiling luminaires and the provision and connection of all control gear together with the laying, jointing and connection of all necessary cables.

All excavation, trenching, backfilling etc., will be undertaken by the main Sub-Contractor.

All lighting columns shall be of the type specified, suitable for looping in and out three No.2 Core PVC/SWA/PVC cables of the specified size.

Where discharge lamps are specified the associated controlgear shall be mounted in the base of the column above the fused 'cut out', all on a timber board housed within the base of the column.

Each lighting column/bollard shall be completed with all adaptors, spigots, mounting brackets, luminaires, controlgear and lamps and shall be provided with a base compartment and locking door.

All column/bollards shall be fixed in the position specified.

Cable routes are shown on the relevant drawings and the electric Sub-Sub-Contractor shall lay the lighting cables in the trenches.

All connections shall be made in an approved manner, and the installations shall be finished complete and handed over in working order to the full satisfaction of the Engineer.

21 LIGHTING SWITCHES

Lighting switches shall be of the type, size and manufacture as specified.

Wall and ceiling switches shall comply with BS 3676. Wall and ceiling switches controlling A.C lighting circuits shall be rated 20 amp and be of the slow break quick make, type unless stated otherwise.

Where several switches on one phase are shown at one position, a ganged box shall be used.

Where switches at any location are connected to different phases, purpose-make phase barrier switches shall be installed. The phases shall be separated by means of rigidly fixed barriers and the cable for each phase shall be confined to the area enclosed by the barriers for that phase.

Switches connected to a particular phase shall have separate cover or covers fitted over each phase. The covers shall be engraved "CAUTION 415 VOLTS".

The switch plate of the specified finish shall be fitted over phase covers to render the switch unit indistinguishable from the switches that are not phase barrier switches.

Alternatively, each gang shall have its own piping and box for each phase, physically separated from other phases with similar arrangements.

For flush position on a plastered or equivalent finish wall, the switches shall have overlapping plates.

In any places where the finish is fair-faced brickwork, the wiring shall be installed on the back of the wall and make a back entry into the accessories. Each switch in these areas shall be neatly recessed and incorporate an overlapping plate.

For surface-mounted positions and such Plant Rooms, Electrical Switch room etc., employing a surface-mounted system or wiring, switches shall be surface-mounted, having metal front plates of an aluminium finish, mounted in matching metal boxes.

22 SOCKETS OUTLETS

All socket outlets and plugs shall be supplied and installed in accordance with the manufacture, type, sizes and finish specified.

All round pin 2A, 5A, 15A, and 30A socket outlets shall comply with the requirements of BS 546.

All sockets outlets shall be switched, unless otherwise specified.

All switched sockets outlets shall be complete with steel boxes of the same manufacture, complete with earth terminal.

Assemblies shall comply fully with the requirements of the IEE Regulations concerning the bonding of protective conductor terminals and each such terminal shall be connected by a conductor, having a minimum cross-sectional area of 2.5 mm², to a permanent earthing terminal incorporated in the associated box providing an effective, solid connection to the earth continuity conductor of the installation.

Where the assembly does not provide a reliable electrical contact between the cover plate and box with effective connection of metal operating bars and toggles, then an insulated earthing lead shall be provided, solidly connected to the metal plate and operating bar or toggle and terminating at the fixed earthing terminal incorporated in the associated box. 13 amp sockets will generally be installed using ring circuits in accordance with Appendix 5, Table 5A of the IEE Regulations.

All plugs shall be of moulded rubber or other resilient material complying with BS 1363 or BS 546. The plug shall have internal cord grip. 13 amp plugs shall be fitted with cartridge fuse links to BS 1362. The fuse rating shall be selected to give protection to the flexible cord or cable connected.

All fuses installed within 13 amp plug top, fused spurs, clock connections etc., shall be cartridge fuse links rated at 240 volts, ASTA certified for compliance with BS 1362 'General purpose fuse links for domestic and similar purposes', or BS 464 'Cartridge fuse links (rated at up to 5 amperes) for AC and DC service', or BS 2950 'Cartridge fuse-link for telecommunications and light electrical apparatus'.

All equipment, which is locally fused, shall have fitted fuses with characteristics, which are recommended by the manufacturer of the equipment.

If any appliance or equipment suffers due to incorrect fusing of the appliances, such appliances or equipment shall be repaired or replaced at the electrical Sub-Sub-Contractor's cost, to the satisfaction of the Engineer.

23 INSPECTION AND TESTING

A visual inspection shall be made in accordance with IEE Regulations 612-1. References shall be made to appendix 14 of the IEE Regulations, which is a checklist for initial inspection of installations.

The electrical installation shall be inspected and tested by the electrical Sub-Sub-Contractor in accordance with part 6 of the IEE Regulations.

Where any part of installation is to be concealed within a building, fabric tests shall be made to ensure that the installation is satisfactory prior to concealment.

Upon completion of the works the whole installation shall be subjected to the tests detailed hereafter and every defect shall be noted, corrected and brought to the notice of the Engineer.

All tests shall be witnessed by the Engineer to his full satisfaction and he shall be given at least one week's notice in writing of the proposed tests.

All labour and test instruments shall be provided by the electrical Sub-Sub-Contractor and the instruments shall be correctly calibrated and certified for the limits of accuracy required and shall be operated by competent person. If, in the Engineer's opinion, a particular instrument is not suitable, then an acceptable alternative shall be provided. The Engineer shall be at liberty to demand the use of any testing instrument or apparatus that he may reasonably consider to be necessary in the execution of the testing.

In the event of the installation failing to pass the test, the Engineer has the full authority of the Employer to deduct from the Contract Price all reasonable expenses incurred, due to him being required to attend a repetition of the test.

The following items, where relevant, shall be tested in the sequence indicated. Standard methods of testing, in respect of some of the following regulations of this section, are given in Appendix 15 of the IEE Regulations.

- i) Continuity of ring final circuit conductors.
- ii) Continuity of protective conductors, including main supplementary equipotential bonding.
- iii) Earth electrode resistance.
- iv) Insulation resistance.
- v) Insulation of site-built assemblies.
- vi) Protection of barriers or enclosures provided during erection.
- vii) Insulation of non-conducting floors and walls.
- viii) Polarity.
- ix) Earth fault loop impedance.
- x) Operation of residual current devices and fault voltage operated protected devices.

Upon completion of all tests and commissioning, two copies of detailed certificates shall be provided by the electrical Sub-Contractor to show that the equipment, materials, installation etc., have been tested and commissioned. One copy of each, duly completed and signed shall be submitted to the Engineer within 154 days of the results being obtained. The second copy of the certificates shall be retained to be included with operator and maintenance manuals.

The results of the test and details of completion for the electrical test shall be detailed on the Test and Completion Certificates respectively; issued by the National Inspection council for Electrical Installation Contracting or other approved authority.

24 AS BUILT DRAWINGS, AND DOCUMENTATION

Within one month of the date of completion the electrical Sub-Contractor shall provide 3 prints of all electrical drawings showing the electrical installations "As built". In case the electrical Sub-Contractor fails to provide "As Built" drawings as required, these will be prepared by others at the expense of the electrical Sub-Contractor.

PART B:

PARTICULAR SPECIFICATION

FOR ELECTRICAL INSTALLATIONS

PART B: PARTICULAR SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

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PART B:

PARTICULAR SPECIFICATIONS

SECTION 1: GENERAL

- 1.01 The electrical Sub-Contractor shall supply labour and supply, deliver, install, fix, connect, test, label, and commission the electrical works, clean, complete and working to every detail as described in the specification and by related specifications to the satisfaction of the Consulting Engineer/Architect.

A Main Switchboard shall be installed in the switchroom provided and shall be fed directly from KPLC Mains Incomer.

The works shall include but not necessarily be limited to the following installation:

- a. Sub-main power cabling
- b. Sub-main distribution board consisting of a segregated PLC section and a 24V dc PLC power supply
- c. Generator Installation
- d. UPS installation
- e. Automatic Voltage Regulator installation
- f. Distribution cabling
- g. Earthing & Bonding
- h. Supplies to air conditioning plant and hand dryers
- i. Audio Visual system wireways
- j. Fire Alarm system
- k. Solar Installations
- l. Lighting system with necessary controls
- m. Small power

1.02 Exclusions

Excluded from this Sub-contract is:-

- i) Control panels for air conditioning plants and internal wiring between control-panels, motor thermostat. etc.

Power supply cables to air conditioning plants shall terminate at isolators mounted local to control panels. The isolators are included in this sub-contract.

SECTION 2

SUPPLY AND DISTRIBUTION

2.01 Supply and Distribution system

A maintained power supply shall be taken from newly installed main LV switch board located in the Switch Room.

2.02 Main Switch Board

A new main distribution board shall be introduced under this sub-contract. The board shall be constructed to Form 4 and shall consist of intelligent circuit breakers and a PLC section. The PLC's shall then be wired to a SCADA system. A 24V dc battery power supply unit shall also be provided for the PLC's.

An Automatic Voltage Regulator and a Surge Suppressor shall be connected up-stream of bus-bars as shown on the drawings.

The schematic showing the sub-main switchboard and the distribution system is shown on drawing no. E1405-33A –E1405-33C. Sub-switch room details, including trenching, are as shown on drawing no. E1405-39

All switch fuses, fuse switches, MCB's including meters shall be of reputable manufacture meeting current British and Kenya Standards as stipulated in the general specifications. Any other quality that do not strictly meet these standards shall not be acceptable.

Unless specifically stated otherwise, power cabling from the sub-board to various plant and equipment shall be by armoured cables drawn into ducts or run on trays. All circuit breakers in the Sub board are to be motorized and set at different timings to allow for sequential loading of the standby generator. Exact trunking details to be given at the time of approving shop drawings for the sub switchboard.

The SCADA shall consist of the following hardware specifications:

- 1 No. 10A SP/N MCB
- 1 No. Micro TSX3721 PLC complete with
 - (i) A rack which integrates a 100/240 Vac power supply
 - (ii) A processor including a 20K word memory + data memory, 1 Flash EPROM back-up memory
- 1 No. Discrete input/output module (32 inputs 24 Vdc and 32 solid – state outputs)
- 2 No. Discrete input/output module (8 inputs 24Vdc and 8 solid-state outputs)
- 1 No. Web-Server Ethernet TCP/IP module
- 5 No. Interface Sub-Bases for inputs and outputs complete with connectors and cables
- 1 No. Back-up Battery
- Set of communication cables (Unitelway Protocol – Allow for a max distance of 10m between SCADA computer and PLC)
- 1 No. Power supply for Web-Server
- 1 No. Set of terminals for external cable connections

SECTION 3

LIGHTING AND SMALL POWER INSTALLATIONS

3.01 INSTALLATION SYSTEM

With the exception of where otherwise noted on the drawings, the installation shall throughout be carried out in PVC insulated copper cables of not less than 1.5 mm² copper drawn in high grade PVC conduit.

3.02 LIGHTING CONTROL SYSTEM

Chamber Lighting

- 3.03 Lighting within the Chamber shall be controlled from a lighting control panel to be installed in the Hansard Room.
Elsewhere the lighting shall be controlled at locations indicated on drawings.

- 3.04 The lighting control panel shall be purpose made to the approval of the Engineer.

- 3.05 Types of accessories and fixed apparatus to be used shall be as manufacture MK or Crabtree. Subject to the approval of the Engineer equivalent makes may be used. All light fittings to be of manufacture shown on the detailed descriptions, or approved equivalent.

3.04 CONNECTIONS TO FIXED APPLIANCES

The Sub-contractor shall supply and interconnect flexible cords between spur units/outlets boxes and the appliances where the symbol for flex connections are shown.

All connections shall be made by white heat-resisting PVC flexible cords having fuse rating in accordance with the respective circuits subjected to a minimum of 0.75mm².

3.05 MOUNTING HEIGHTS AND LOCATIONS

All mounting heights stated shall mean the heights from finished floor level to underside of the accessory.

Each mounting heights for wall fixtures shall, however, be re-confirmed on site.

Lighting control Switches

1400 mm above floor level and 100 mm away from architrave. If mounted in a column they shall be located in the centre.

Sockets Outlets

300 mm above finished floor except for areas that are otherwise stated.

Connection Units and Outlets

Connection units having cord outlets shall be located as to limit the length of the flex cord to approx. 600 mm and be located slightly higher than the inlet on the appliances. The same applies to outlet boxes.

Conduit Boxes (General)

Where one fitting is shown in a room the box shall be in the centre (unless otherwise stated). Where two or more fittings are to be installed they shall be half of the between two fittings. Where one row of fittings is to be installed they shall be located in the centre. Where installed between beams they shall be in between two beams. All boxes shall be with covers.

3.06 WALL AND CEILING FINISHINGS

The Sub-Contractor is to obtain information regarding the ceiling claddings before any installation is commenced as he will be held responsible if the conduit boxes as well as boxes for switches and socket outlets, telephone, etc are not installed at the right depth.

3.07 LIGHTING FITTINGS

The sub-Contractor shall supply, deliver to site, install and commission all the fittings.

The tenderer may submit an alternative schedule of equal makes of fittings with the tender where applicable.

Where appliances fittings shall be supplied complete with bulbs or tubes, the tubes shall be as as indicated in the Bills. Equivalent makes may be substituted subject to due approval of the Engineers, and the sub-contractor proving that what is specified is not available.

3.08 FIXING AND LOCATION

Details of fixing and location of various fittings are as shown on relevant drawings.

A rubber gasket shall be fitted on the conduit boxes for the outdoor fittings in order to provide a waterproof seal.

- 3.09 All switch panels shall be as MK manufacture or equivalent subject to the Engineer's approval. Each panel shall be fed from a particular phase as NOT more than one shall be allowed inside one panel. Separate conduits shall be installed to each panel.

3.10 POWER INSTALLATIONS

The sub-Contractor shall include for all installations shown on the drawings.

The sub-contractor shall satisfy himself that there is a continuous conduit, trunking and /or duct system to facilitate installation of the entire power installation and shall be held responsible where continuity does not exist.

3.11 INSTALLATION SYSTEM

The installation system for the indoor installation shall be carried out in concealed PVC conduits, PVC ducts and surface mounting trunking. The size of the cables shall not be less than 2.5 mm² for ring main circuits.

SECTION 4

4. FIRE ALARM SYSTEMS

4.01 INSTALLATION

The installation for the above shall be carried out using PVC 1.5mm² copper cables in high impact grade PVC conduit. All cables for fire alarm installations to be fire-resistant. Tests for fire resistance will be performed as part of this sub-contract.

The sub-contractor shall ensure continuous link-up between individual break-glass call units, detectors, bells and panels.

SECTION 5

INSTALLATION FOR AUDIO VISUAL SERVICES WIREWAYS

5.01 INSTALLATION SYSTEM

In the tender for electrical installations supports for all cables in the audio visual services shall be included. The electrical tender shall include for trunking, trays, conduits etc. to ensure a continuous supply system from Equipment rooms to any individual outlet.

Holes in structures shall be provided by the main-contractor.

Where equipment are fixed on wall, the conduits shall at each point terminate in deep switch-boxes as specified for lighting control switches.

5.02 MOUNTING HEIGHTS AND LOCATIONS

Mounting heights shall be as indicated on drawings.

5.03 BLANK-OFF PLATES

As MK list No. 3827 white where required.

SECTION 6:

TESTING OF AUTOMATIC VOLTAGE REGULATORS, UNINTERRUPTIBLE POWER SUPPLY UNITS AND STANDBY GENERATORS

The sub-contractor shall:-

- i) Prepare a detailed schedule of testing of automatic voltage regulators, uninterruptible power supply units and standby generators.
- ii) The schedule shall be discussed in detail with the engineer, and testing shall only proceed if the procedures outlined therein are acceptable to the engineer, and/or are considered practicable.
- iii) For the AVR and UPS units, the tests shall include the following:-
 - Subjecting each unit to the full, rated power (in KW) with capability for intermittent 10% overload. Each unit must be able to accept the full rated (resistive load) indefinitely. The tests to be conducted off-site.
 - **While still connected to the full load** the input to each unit (whether AVR or UPS), will be fed via a 60% to 140% POTENTIOMETER, and the input voltage supply varied over the $\pm 30\%$ range.
 - The input variation **MUST NOT** cause any adverse variations on the output as long as the input remains within $\pm 30\%$ range. The provision of an adequately rated POTENTIOMETER for the purposes of these tests to be included in the sub-contract price.
 - **Each unit of equipment** to be tested separately. Permission to transport the units to site shall only be granted after satisfactory tests are achieved.
- iv) For the standby generator, only the full load test shall be conducted off-site. The testing to be done as outlined.

PART C:
TECHNICAL SPECIFICATIONS
FOR STRUCTURAL
LIGHTNING PROTECTION

PART C: TECHNICAL SPECIFICATIONS FOR STRUCTURAL LIGHTNING PROTECTION

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PART C:

TECHNICAL SPECIFICATIONS FOR STRUCTURAL LIGHTNING

1.0 DESIGN CONSIDERATIONS

This consideration is based on the provisions of BS 6651.

If it has been established that a structure requires lightning protection, certain general design considerations need to be made.

Could, for instance, any of the metallic components in or on the structure be incorporated into the lightning protection scheme? Could the metal in and on the roof be used? Should window cleaning rails, window frames, handrails surrounding the structure be incorporated in the protection network? The reinforcing bars or the steel frame of a structure may well provide a conductive path within the lightning protection system.

If metallic components in a building are not used, then the structure will require externally fitted conductors. A Lightning Protection System can incorporate all natural conductors, all externally fitted conductors, or a combination of both. BS 6651 does not, however recommend the routing of conductors inside the structure.

2.0 MAJOR COMPONENTS

The principle components of a lightning protection system should comprise the following:

- Air termination networks
- Down conductors
- Earth termination networks
- Bonding to prevent side flashing

2.1 Air Termination Networks

It is now accepted that lightning can strike the upper part of tall structures. BS 6651 now introduces the concept of air termination networks on all sides of tall buildings (ie, vertical air termination networks). No part of the roof within the air termination network should be more than 5m from a conductor. For large flat roofs, this will be achieved typically by a network mesh of 10m x 20m. For high risk structures, ie, explosive factories, etc. the air termination mesh is reduced to 5m x 10m.

If a building's metal reinforcing bars are to be used as down conductors, these should be connected to the air termination network in the correct number of positions.

BS 6651 advises the use of a rolling sphere to determine zones of protection. To minimize the likelihood of a lightning strike damaging the side of the buildings, it is suggested that the rolling sphere method be applied to identify those areas where an extension of the air termination network should be considered. This recommendation could be summarized as follows:-

Where there is a risk that a lightning strike to the sides of a structure may cause masonry to be dislodged, then an extension of the air termination network should be considered.

To ensure complete continuity of the lightning protection system BS 6651 recommends that:

Where structures vary in height and have more than one roof termination network, the lower roof network should not only be joined to its down conductors, but also joined to the down conductors of the taller portions of the structure. This will ensure that a lightning strike to a lower portion of the structure will not lead to side-flashing to other 'remote' down conductors and will provide a multi down conductor path for the lightning current to disperse.

The protective systems of churches and similar non-conducting structures should include air termination networks, down conductors and earth termination networks. It is, however, very difficult to design protective systems for these structures collectively. BS 6651, therefore, advises that such structures should be treated as special cases: that the presence of a tower or spire should be disregarded when designing the protection of the lower parts of the structure.

For less complex tall structures of varying heights, the 'rolling sphere method' as described should be employed. The rolling sphere method is a simple means of determining where the zones of protection should be located. Wherever the sphere touches the structure determines the extent of the air termination network.

There is a reference in BS 6651 to the use of covered conductors for air termination networks. Although it advocates that, wherever possible, bare conductors should be used, it permits the use of PVC covered or painted conductors.

2.2 Down Conductors

The function of a down conductor is to provide a low impedance path from the air termination network to the earth termination network, to allow the lightning current to be safely conducted to earth.

BS6651 advocates the use of various types of down conductors. A combination of strip and rod conductors, reinforcing bars, structural steel stanchions, etc. can be used as all or part of the down conductor system-providing they are appropriately connected to the air and earth termination networks, and are known to offer good electrical conductivity.

The code suggests there is no advantage in using 'shielded' coaxial cables as down conductors. In fact there is thought to be the disadvantage that potentials up to hundreds of kilo-volts can occur between the inner and outer conductor (shield) at the top of the down conductors so triggering a side flash.

Down conductor systems should, where possible, take the most direct route from the air termination network to the earth termination network. Ideally they should be symmetrically installed around the outside walls of the structure starting from the corners. Routing to avoid side-flashing should always be given particular attention in designing any installation.

Down conductors should be positioned no more than 20m apart around the perimeter at roof or ground level, whichever is the greater. If the structure is over 20m in height, then the spacing is reduced to every 10m or part thereof.

Sharp bends in down conductors at the edge of the roofs are unavoidable and are permitted in BS 6651; however, re-entrant loops in a conductor can produce high inductive voltage drops which could lead to the lightning discharge jumping across the side of the loop. To minimize this problem BS 6651 recommends that the length of the conductor forming the loop should not exceed eight times the width of the open side of the loop.

2.3 Earthing – General

Earthing plays a vital role in all electrical systems. The main reasons for earthing are:-

- To protect people and livestock
- To protect equipment
- To permit the equipment to function correctly
- To ensure the reliability of electrical services.

A good earth connection should possess the following characteristics:-

- Low electrical resistance between the electrode and the earth. The lower the earth electrode resistance the more likely the lightning or fault current will choose to flow down that path in preference to any other, allowing the current to be conducted safely to and dissipated in the earth.

- Good corrosion resistance. The choice of material for the earth electrode and its connections is of vital importance. It will be buried in soil for many years so has to be totally dependable.
- Ability to carry high currents repeatedly.
- Ability to perform the above functions for a minimum of 30 years.

2.4 Soil Conditions

Achieving a good earth will depend on local soil conditions. A low soil resistivity is the main aim, and factors that affect this are:

- Moisture content of the soil.
- Chemical composition of the soil, eg. Salt content.
- Temperature of the soil.

Note: It is now deemed bad practice to use salt as a chemical means of reducing soil resistivity, because of its very corrosive nature. Salt along with other chemicals, has the disadvantage of leaching out of the surrounding soil after a period of time, thus returning the soil to its original resistivity.

Once the soil resistivity has been calculated from the local soil measurements, the appropriate earth electrode system can be chosen by using typical formulae listed below:

Horizontal Strips (Rectangular Section)

$$R = \rho / 275L \text{ Log}_{10} 200L^2 / wD$$

Horizontal Strips (Circular Section)

$$R = \rho / 275L \text{ Log}_{10} 100L^2 / dD$$

Vertical Strips (Rectangular Section)

$$R = \rho / 275L \text{ Log}_{10} 800L / w$$

Vertical Strips (Circular Section)

$$R = \rho / 275L \text{ Log}_{10} 400L / d$$

Where:

R= Apparent earth electrode resistance in ohms.

ρ = Soil resistivity in ohm.cm

D= Depth of electrode in metres.

d= Diameter of electrode in centimeters.

L= Length of electrode in metres.

W= Width of electrode in centimeters.

Assume we use a standard 5/8" diameter rod (nominal diameter 14mm) Actual shank diameter 14.2mm

Thus $d = 1.42\text{cm}$

$L = ?$

If we let $L = 6\text{m}$ and substitute to see what value of R is obtained

$$R = 10,000 / 275 \times 6 \times \text{Log}_{10} 400 \times 6 / 1.42$$

$$= 6.0606 \times 3.228$$

$$= 19.56 \text{ ohms}$$

Thus 6m of extensible rods (5x1.2m) can be used to obtain the desired resistance value of 20 ohms.

The above example illustrates the importance of the accuracy of the soil resistivity figure. If the survey is inaccurate, then the calculated apparent electrode resistance R will be inaccurate and misleading.

2.5 Solid Plates or Mats

Earth plates or mats can be buried instead of driving rod electrodes but installation is expensive and time consuming.

2.6 Reinforcing bars in foundations as natural earths

This is an economical method of using the mass of metal already underground in the form of the re-inforcing bars, within the structure's foundations. Precautions should be taken to ensure there is electrical continuity between these re-inforcing bars and the earth/lightning protection connections above ground.

2.7 Underground Pipe Work System

Buried water pipes were previously considered to be a reliable method of earthing but the increasing use of plastic pipes or replacing metal joints with plastic ones now makes this method unreliable.

Other forms of earth electrode can be used, including ring conductors or radial strips emanating from a particular point, or a combination of conductors with earth rods.

2.8 Voltage Gradient

A further factor affecting the choice of an electrode system is the electrical considerations.

Step and touch voltages on the surface of the ground in the vicinity of earth electrodes must be restricted to safe values.

This can be achieved by using electrodes to form a ring around the area to be protected. The electrodes must be buried sufficiently deep to reduce surface potential.

An effective method of reducing the voltage gradient of rod electrodes is to install them with the top of the electrode some distance beneath the surface of the soil. The connection between the electrode and down conductor being made with insulated conductor.

An example of how effective this can be is illustrated by tests which gave the following results.

The maximum voltage gradient over a two metre span adjacent to a 25mm diameter earth electrode was 85% of the total electrode potential when the top of the assembly was at ground level. This electrode potential was reduced to 20% when the electrode was buried 0.3 m below ground level and 5% when buried 1.0 m below ground level.

One of the biggest problems for the installation contractor is of obtaining an earth resistance of, say, one ohm or less in an area of high soil resistivity. Unfortunately, there is no magical solution. However, several options are available to the contractor in the form of soil conditioning agents.

2.9 Soil-Conditioning Agents

Introducing a soil conditioning agent into the ground can reduce the soil resistivity and hence reduce the earth resistance.

There are various agents available, the choice of any particular one will depend on the type of earth required – temporary or permanent; the locality; the condition of the soil, etc.

As previously mentioned moisture forms an important part in obtaining a low soil resistivity value and it is the impurities in the water that produce this. One way of reducing the soil resistivity is to pour chemical solutions i.e.: copper sulphate; sodium carbonate; calcium sulphate, over the local area and allow it to migrate through the soil. The disadvantage of this is the large volume of solutions required, which makes it a cumbersome and time-consuming exercise. Also chemicals will eventually leach out of the local soil, returning it to its original high resistivity. Dissolving chemicals into the soil is also likely to encourage corrosion of the earth electrode. Hence the reason for the British Standard Code of Practice 7430 on Earthing and BS6651 Protection of Structures against Lightning – not recommending the use of a salt as a means of reducing the soil resistivity.

Other soil-conditioning are available including Bentonite and Marconite.

Bentonite is used as an earth-electrode back-fill to reduce soil resistivity by retaining moisture. The clay consists largely of sodium montmorillonite, which when mixed with water swells to many times its dry volume. It has the ability to hold its moisture content for a considerable period of time and to absorb moisture from the surrounding soil (e.g. from rainfall).

Marconite is a conductive carbonaceous aggregate which when mixed with conventional cement, effectively increases the surface area of the earth-electrode, thus lowering its earth resistance. Ideal for use on sub-stations and transmission/distribution networks or in hot, dry climates, and also has electromagnetic screening and anti-static flooring applications.

Both products have applications with deep-driven electrodes. The ground/soil in question can be drilled using a portable drill rig, transported to the site. Significant depths can be reached depending on the type of ground.

The electrode assembly can then be inserted into the pre-drilled hole and back-filled with Bentonite or Marconite, or any other appropriate conditioning agent.

It is vital with any earthing system that regular inspection is carried out for possible damage. Regular checks on earth electrode resistance to ensure optimum protection are advised.

The key to arriving at a successful earthing electrode system is not to sacrifice quality for cost. Many products currently on the market fall far short of the recommended standards. BS 7430: 1991 Code of Practice for Earthing contains recommendations for material specification to ensure components are corrosion-resistant and provide adequate mechanical strength.

The correct choice of material and installation should ensure a life span of 30 years for the earth electrode.

2.10 Earthing – Lightning Protection Systems

There are two stages in testing an earth network for satisfactory resistance.

- 1) An earth electrode should be connected to each down conductor with a test link incorporate into every down conductor path.

With the test link removed and without any bonding to other services, etc, the earth resistance of each individual earth electrode should be measured. The resistance, in ohms, should not exceed ten times the number of down conductors on the structure. For example, if there are fifteen down conductors equally spaced around a building, then the resistance of each electrode with the test link removed should not exceed $10 \times 15 = 150$ ohms.

- 2) With the test links replaced the resistance to earth of the complete lightning protection system is measured at any point on the system. The reading from this test should not exceed ten ohms. This is still without any bonding to other services.

BS 6651 provides a guide to the minimum dimensional requirements of various electrode systems. For example, where earth rods are chosen, the minimum combined rod length to complete an earth electrode system should be 9 metres – therefore a small structure with only two down conductors would have a minimum requirement of 4.5 metres for each electrode. Each local earth rod electrode should be a minimum length of 1.5 metres.

It must be remembered that this dimensional requirement does not effect, in any way, the need to obtain the satisfactory earth resistance values mentioned in (1) and (2) above.

3.0 BONDING

All metal work on or around a structure must be bonded to the lightning protection system if side-flashing is to be avoided. When a lightning protection system is struck, its electrical potential with respect to earth is significantly raised and, unless suitable precautions are taken, the discharge may seek alternative paths to earth by side-flashing to other metal-work in or on the structure.

Typically, water pipes, gas pipes, metal sheaths and electrical installations which are in contact with earth, remain at earth potential during a lightning discharge. Even metal parts that are not in contact with earth will see a potential difference between them and the lightning protection system during a discharge, even if this potential is smaller in magnitude to the metal parts in direct contact with earth.

It is vital that all exposed metal work is bonded into the lightning protection installation.

There are two ways of preventing side-flashing. The first is to isolate nearby metal from the lightning protection system. So, even if a strike occurs, the clearance distance between the metalwork and the lightning protection system would be so great that the strike would prefer to follow the lightning protection path rather than jump across to the metal work. Obviously, this will not be practical for certain fixed metal installations, for example central heating systems or metal windows. In these cases, the second method of preventing side-flashing has to be considered, that of connecting the metal work to the lightning protection system with an appropriate bond.

To determine whether the distance between the suspect metal work and the lightning protection system is large enough for the metal work to be considered 'isolated' or close enough to be 'bonded' BS 6651 provides a mathematical means of determining the minimum isolation distance for a given set of parameters.

Simple formulae are used in conjunction with two curves to evaluate the minimum isolation distance required between the suspect metalwork and the lightning protection system. If the figure obtained, with the given set of parameters, results in, say, a separation distance, of 2m, then if the actual gap is less than 2m, bonding is required. If the gap is greater than 2m, then isolation is sufficient, and no bonding is required.

BS6651 also provides specific recommendations for protecting buildings which contain explosives or highly flammable contents, dwelling houses/domestic properties, fences, trees and structures near trees, structures with radio and television aerials and a whole range of other miscellaneous structures including tents, sports stadiums, bridges, etc.

The code also mentions that internal bonds can be half the cross sectional area of external bonds as they are, at most, only likely to carry a proportion of the total lightning current.

3.1 Corrosion

As mentioned earlier the correct choice of materials for a lightning protection system is vital. Metal fittings must be compatible with the metal or metals used externally on the structure over which the system passes or with which it may be in contact.

Aluminium and copper, the two metals most commonly used in lightning, protection systems, are not compatible, so great care must be taken when both are used in a system – particularly where they come into contact with each other.

If aluminium is selected as the material for air termination networks and down conductors, it has to be connected to copper at or around the test clamp. This connection should be positioned at the beginning of the earth termination network. This is because both BS 6651 and the Earthing Code BS 7430 do not permit aluminium to be buried underground.

Simple and effective means of joining aluminium and copper conductors in one connector do exist. Ingots of high purity copper and aluminium are friction welded together forming an effective electrical and mechanically robust joint. This termination, if used in conjunction with contact inhibitor grease minimises the effect of corrosion.

The contact surfaces of dissimilar metals should be kept completely dry and protected against the ingress of moisture, otherwise corrosion will occur. A particularly effective means of excluding moisture is to use inhibitor pastes, bitumastic paint, or approved protective wrappings.

As aluminium is prone to corrosion when in contact with Portland cement and mortar mixes, aluminium conductors need to be fixed away from the offending surface with an appropriate fixing.

Earth conductors between the test clamp(s) and earth electrodes should be protected against corrosion where they enter the ground for a distance of 0.3m above and below ground level. This can be achieved by using PVC protective sleeving.

4.0 LIGHTNING PROTECTION DESIGN

For a well-designed lightning protection system, the following information will be required:

1. Drawings of the structure requiring protection, showing the roof plan and at least two elevations. These drawings should be clear, precise and have the scale shown.
2. The materials used in the construction of the structure should be stated along with information on the type of fixings permissible (e.g. can the roof be drilled to take screw plugs).
3. For what purpose is the structure being used? (i.e. its use will determine the risk category of the structure).
4. The proximity of other structures, trees and its general locality.
5. Information regarding any unusual features such as aerial masts on the roof of buildings, which may not be shown on the drawings.
6. At what stage of construction is the structure (i.e. complete, partly built, etc).
7. Notification of code that the scheme is to be designed to e.g. BS 6651 (1992).
8. Is there any soil resistivity data available?

5.0 EARTHING SYSTEM DESIGN

General statements regarding earthing have been made earlier. This Section however is specifically aimed at assisting with earth electrode calculations – whether they be for a simple power earth, or for a more complex design, say a high voltage sub-station.

5.1 Why do we require an Earth?

The function of an earth system for an electrical installation can be split into three broad bands:

- i) To limit the potential of any part of the installation to a pre-determined value with respect to the general mass of earth.
- ii) To permit the flow of current in the event of a fault to earth so that the protective equipment has time to operate and thus isolate the faulty circuit.
- iii) To ensure that, if a fault occurs, non current carrying metalwork associated with the equipment does not attain a dangerous potential respect to the general mass of earth.

Points (i) and (ii) are normally essential to the security of the system, and are generally known as system earthing.

Point (iii) is aimed at ensuring safety of humans, animals and property and is sometimes known as equipment earthing.

5.2 How do we choose our Earth Electrode System?

Having determined that there is an earthing requirement, how do we go about deciding what type of earth electrode we should use? The previous chapter elaborated the various types of earth termination networks available, and their differing properties are a major consideration. However, the most significant factor that will govern our choice is the ground itself. A borehole survey of the ground where the earthing is to be installed will indicate whether rock is present and at what depth, a factor that will not only affect the electrical consideration but will also have a direct bearing on installation costs. The information required by the earth electrode designer, however, is the resistivity of the soil: that value of “rho” that will enable him to calculate the earth resistance – i.e. the resistance of the soil to the passage of electric current.

Compared to a length of copper conductor the soil or earth could be regarded as a relatively poor conductor of electricity; for example, the resistivity of copper is 1.72×10^{-8} ohm metres, whereas chalk in Norfolk might register a value of 100 ohm metres. In reality, however, the earth’s enormous mass, and, hence, its large cross-sectional area for the current path, gives it quite a low resistance, i.e. – the earth is, in fact, a good conductor. Since soil strata differs significantly from country to country, or even from site to site, it is not possible to be specific about the correct choice of earth electrode system without carrying out a detailed soil resistivity survey.

5.3 Soil Resistivity Measurements

A technique for measuring the earth’s resistivity was proposed by the American, Dr. Frank Wenner, in a scientific paper published in 1915. Since that time it has been universally accepted as the most popular method to employ.

The Wenner method gives the average resistivity of the soil between ground level and a given depth. Using this method, Furse site surveys measure the soil resistivity of various depths up to a minimum of 20 metres. This enables the plotting of a soil resistivity v. depth graph to reveal the optimum earth electrode system and where in the soil-strata it should be located.

5.4 Earthing Design

If the objective is to achieve a desired resistance to earth for a particular installation, e.g. one ohm, then formulae given in BS 7430 (1991) can be used to calculate the required amount of electrodes. If the earthing requirements are more comprehensive, for instance achieving a stipulated resistance to earth and also addressing the problems associated with step and touch voltages, then an internationally accepted standard such as IEEE standard 80 (1986) – Guide for Safety in AC Substation Grounding, should be employed. Other nationally recognised standards on earthing may be used to calculate the earth electrode requirements, but most design efforts concentrate on BS7430 and IEEE80.

For BS 7430 systems the resistance values are calculated to allow the Designer simply to select the ‘bill of quantities’ which gives his required resistance. IEEE80 designs include a schematic drawings representing the earth grid layout; from this, accurate site installation drawings can then be produced.

PART D:
TECHNICAL SPECIFICATIONS
FOR FIRE ALARM SYSTEM

PART D:

TECHNICAL SPECIFICATION FOR FIRE ALARM SYSTEM

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SECTION A:

1.0 SYSTEM DESIGN

1.1 The Code of Practice for design, installation and servicing

This specification is for the design and installation of fire detector alarm systems for general applications and is based on BS5839 Part 1: 1988.

1.2 Property Protection

A satisfactory fire alarm system for the protection of property will automatically detect a fire at an early stage, indicate its location and raise an effective alarm in time to summon the fire fighting forces (both resident staff and fire brigade).

The general attendance time of the fire brigade should be less than 10 minutes. Therefore an automatic direct link to the fire brigade is essential.

1.3 Life Protection

A satisfactory fire alarm system for the protection of life can be relied upon to sound a fire alarm while sufficient time remains for the occupants to escape.

2.0 ZONE DETAILS

2.1 Zoning of the system

To ensure a fast and unambiguous identification of the fire source, the protected area should be divided into zones.

When determining the area to be covered by a zone, consideration should be given to accessibility, size, the fire routine determined for the premises, and particularly in occupied premises, that each zone is accessible from the main circulation routes leading from the where the control panel is sited.

In general the following guide lines for the size of a zone should be observed:

1. **If the total area** (i.e. the total of the floor areas of each storey) of the building **is not greater than 300m²** then the building need only be one zone, no matter how many floors it has.
2. **The total floor area** for a zone should not exceed **2000m²**.
3. **The search distance should not exceed 30m.** This means the distance that has to be travelled by a searcher inside a zone to determine visually the position of a fire should not exceed 30m. The use of remote indicator lamps outside doors may reduce the number of zones required.
4. **Where stairwells or similar structures extend beyond one floor but are in one fire compartment,** the stairwell should be a separate zone.
5. **If the zone covers more than one fire compartment, then the zone boundaries should follow compartment boundaries.**
6. If the building is split into several occupancies, **no zone should be split between two occupancies.**

Notes:

1. A fire compartment is an area bordered by a fire resisting structure usually at least 30 minutes resistance.
2. Zone limits can be relaxed only in certain manually operated systems.

3. It may be an advantage to have manual call points on separate zones to detectors. This will avoid misleading information regarding the position of fire, particularly on staircase landings.
4. Removal of a detector from a zone circuit must not isolate a break glass call point on the same circuit.

3.0 ADDRESSABLE SYSTEMS

In an addressable system several zones may be connected to the control panel by a single loop circuit.

Maximum area covered by one loop is 10,000 sq m.

In addressable systems the detector or manual call point in alarm can be shown by the use of an alpha numeric display. This on its own will not be acceptable and the zone in which the detector/manual call point has operated must be displayed.

The zonal indication may be mounted adjacent to the control panel, and the plan of the building/floor should also be displayed. This means, the use of mimic diagram would seem to be the most suitable means for zone identification.

However in small systems where the identification of location of an incident by an individual device is not confusing, then zonal information may not be required.

4.0 BREAK GLASS AND MANUAL CALL POINTS

The break glass call point is a device to enable personnel to raise the alarm in the event of a fire, by simply breaking a frangible element and thus activating the alarm system.

The following guidelines should be observed for the correct siting and positioning of break glass call points:

1. Break glass call points should be **located on exit routes** and in particular on the floor landings of staircases and at all exits to the open air.
2. Break glass call points should be located so that no person need travel more than 30m from any position within the premises in order to give an alarm.
3. Generally, call points should be fixed at a height of 1.4m above the floor, at easily accessible, well-illuminated and conspicuous positions free from obstruction.
4. The method of operation of all call points in an installation should be identical unless there is a special reason for differentiation.
5. Manual and automatic devices may be installed on the same system although it may be advisable to install the manual call points on separate zones for speed of identification.

5.0 ALARM SOUNDERS

An important component of any fire alarm system is the alarm sounder, normally a bell or electronic sounder, which must be audible throughout the building in order to alert and/or evacuate the occupants of the building.

The following guidelines should be observed for the correct use of alarm sounders:

1. A minimum sound level of either 65dBA or 5DBa above any background noise likely to persist for a period longer than 30 seconds, whichever is greater should be produced by the sounders at any occupiable point in the building.

2. If the alarm system is to be used in premises such as hotels, boarding houses etc., where it is required to wake sleeping persons then the sound level should be 75dBA minimum at the bedhead.
3. All audible warning devices used in the same system should have a similar sound and be distinct from any other audible alarms used for other purposes. Except in noisy areas where high performance sounders may be required.
4. A large number of quieter sounders rather than a few very loud sounders may be preferable to prevent noise levels in some areas from becoming too loud.
5. It is unlikely that sounder noise levels in a room will be satisfactory if more than one dividing wall or door separates it from the nearest sounders.
6. The level of sound provided should not be so high as to cause permanent damage to hearing.
7. The number of fire alarm sounders used inside a building should be sufficient to produce the sound level recommended, but should in any case be at least two.

5.1 Other requirements include:

1. The sounders should be arranged on at least two separate circuits, so that the failure of one circuit does not cause all sounders in the building to fail.
2. Frequency range between 500 – 1000Hz.
3. Most single doors will cause a 20db drop in sound level. Fire doors – 30db.
4. Where mains sounders are being used to supplement 24V DC sounders, the 240V AC supply should be monitored.
5. To achieve 75db at the bedhead, a sounder should be installed in the bedroom.

6.0 SELECTION OF EQUIPMENT DETECTION TYPES

When choosing the type of detector to be used in a particular area it is important to remember that the detector has to discriminate between fire and the normal environment existing within the building, i.e. smoking in hotel bedrooms, fumes from forklift trucks in warehouses, steam from bathrooms, kitchens etc.

6.1 Heat detectors

Heat detectors may be the Point type (which responds to temperatures surrounding one particular spot), or the Line type (which responds to temperature change along its line).

All Point type heat detectors should include a fixed temperature element operating at a pre-determined temperature. Some may also include a rate-of-rise element designed to operate in response to a rapid rise in temperature. Heat detectors are in general less sensitive than other types of detector and should therefore not be used where a small fire will cause unacceptable losses.

6.2 Smoke detectors

There are two principal methods of smoke detection: the ionisation chamber, and the optical scatter chamber. The detection method chosen will usually depend on the type of risk to be protected against. In the ionisation chamber, an electric current flows between two electrodes and is reduced by smoke. Ionisation detectors are particularly sensitive to small particle smoke such as that produced in rapidly burning fires but are relatively insensitive to large particle smoke such as that produced by overheated PVC or smouldering polyurethane foam. In the optical chamber, light is scattered, or in some cases absorbed by smoke. Optical detectors are more sensitive to large particles found in optically dense smoke, but are less sensitive to the small particle smoke.

Today, optical smoke detectors are more widely used than ionisation types due to the growing use of flame retardant materials in building construction, decoration and furnishings. Careful consideration must be given to any specific risks that might occur.

6.3 Siting and spacing of detectors

In a building the greatest concentration of smoke and heat will generally collect at the highest parts of the enclosed areas and it is here therefore, that detectors should normally be sited. Heat detectors should be sited so that the heat sensitive element is not less than 25mm, nor more than 150mm, below the ceiling or roof. If a protected space has a pitched or north light roof, then smoke detectors should be installed in each apex. The following parameters should be followed when spacing detectors:

The maximum horizontal distance between any point in the area and the nearest detector:

1. Under flat horizontal ceilings and corridors more than 5m wide

- i) For Point type Heat Detectors 5.3m (maximum area 50m²)
- ii) For Point type Smoke Detectors 7.5m (maximum area 100m²)

Heat Detectors

Max area of coverage per detector = 50m²

Max distance covered = 5.3m (for square layout this is 3.5m to wall 7m between detectors)

Smoke Detectors

Max area of coverage = 100m²

Max distance covered – 7.5m (for a square layout this is 5m to wall, 10m spacing)

2. In a corridor less than 5m wide (where adjoining rooms are protected by automatic detection)

ADD to the maximum horizontal distance 50% of the difference between 5m and the actual width of the corridor.

e.g.: In a 2m wide corridor, the difference between: 2m and 5m = 3m
50% of 3m = 1.5m
Maximum distance of travel for a Point type Smoke Detector = 7.5m + 1.5m = 9m

3. In the apex of a pitched or north light roof

A row of detectors should be sited in the apex. One row of detectors should be sited at the highest point, a minimum distance of 0.5m from the vertical wall.

ADD to the maximum horizontal distance 1% for each degree of slope up to a maximum increase of 25%

e.g.: A Point type detector at the apex of a 20 degree slope.
20% of 7.5m = 1.5m
Maximum distance of travel 9m
The maximum area of coverage may also be increased proportionally.

4. Obstructions

- (i) Where the passage of smoke or hot gas from a position to a detector is likely to be disturbed by a ceiling obstruction (such as a beam) having a depth greater than 150mm, but less than 10% of the height of the ceiling, then the horizontal distance should be decreased by twice the depth of the obstruction.

e.g.: For a point type smoke detector obstructed by a beam of 200mm depth Maximum distance of travel

$$= 0.2 \times 2 = 0.4\text{m}$$

$$7.5\text{m} - 0.4\text{m} = 7.1\text{m}$$

- (ii) Where a ceiling obstruction, such as a beam, is greater than 10% of the height of the ceiling then the areas either side of the obstruction should be considered as separate rooms.
- (iii) Ceiling beams less than 150mm can be ignored.

5. Detectors (Other than beam type)

Detectors should not be mounted less than 500mm from any walls or partitions. Where rooms are divided into sections by walls, partitions or storage racks reaching within 300mm of the ceiling, the dividers should be considered as if they reach the ceiling.

7.0 LIMITS OF CEILING HEIGHT

Detectors should not normally be mounted on ceilings higher than the general limits on Table 1 below. If small sections of a ceiling (not exceeding in total 10% of the ceiling area) exceed in height the general limits of the table, those higher sections may be protected by Point type heat detectors provided that the ceiling height in the higher sections does not exceed 10.5m, or by Point type smoke detectors provided that the ceiling height in the higher sections does not exceed 12.5m.

| Limits of ceiling height | | |
|--|---------------------------|--------------------|
| Detector type | Ceiling heights in metres | |
| | General Limits | Rapid attendance |
| Heat detectors BS5445: Part 5 | | |
| Grade 1 | 9.0 | 13.5 |
| Grade 2 | 7.5 | 12.0 |
| Grade 3 | 6.0 | 10.5 |
| Point smoke detectors BS 5445: Part 7 | 10.5 | 15.0 |
| High temperature heat detectors BS 5445: Part 8 | 6.0 | 10.5 |
| Optical beam smoke detectors BS 5839: Part 5 | 25.0 | 40.0 |
| Siting limits for smoke beam detectors | Minimum (m) | Maximum (m) |
| Height of optical beam above floor | 2.7 | 25.0* |
| Optical beam length | 10.0 | 100.0 |
| Distance of optical beam from a flat ceiling or apex | 0.3 | 0.6 |
| Horizontal distance between optical beams measured at right angles to a beam | -- | 14.0 |
| Horizontal distance between optical beam and an adjacent wall or partition. | See Note | 7.0 |

* The height may be increased to 40m provided that the rapid attendance criteria are met.

Note: Generally the beam should not pass closer to the wall or partition than 500mm, and not closer to an obstruction than 500mm. However, up to 3m of the beam may be closer than this.

8.0 CEILING HEIGHT LIMITS WITH RAPID ATTENDANCE

Although an increased ceiling height means that the fire will be larger when it is detected, the size of the fire when fire fighting starts will also depend on the delay between detection and the start of fire fighting. If this delay is small, then the increase in fire size at detection due to a higher ceiling can be acceptable.

If the detection system is automatically connected to the fire brigade either directly or via a central (fire alarm) station and the usual attendance time of the fire brigade is not more than 5 minutes, then the rapid attendance limits of ceiling height given in the table in the top right may be applied. If small sections of a ceiling (not exceeding in total 10% of the ceiling area) exceed in height the limits of the table in the top right, those higher sections may be protected by Point type heat detectors if their height does not exceed 18 metres.

9.0 CONTROL EQUIPMENT

The control and indicating panel will depend on the size of the protected building and the extent of the automatic protection provided.

Specification of equipment would be based on numbers of zone circuits, sounder circuit, battery standby, remote center link ancillary control relays, and other individual customer requirements.

Next to the control unit should be a diagrammatic plan showing zone locations.

Siting of control and indication equipment

1. In an area of low fire risk
2. On the ground floor by entrance used by the fire brigade.
3. In an area common to all building users.
4. Where automatic detectors are in use, the control equipment area must be protected.
5. Alarm sounder must be sited next to the control unit.

10.0 STANDBY POWER SUPPLIES

Standby supplies will usually be from secondary batteries with automatic chargers. These batteries must have an expected life of at least 4 years and the code specifically bans the use of automotive type batteries.

When the mains supply fails the standby must be able to operate the alarm load for 30 minutes after a certain minimum duration. The minimum duration varies with the type of system and building occupancy.

For life protection (L) if a mains failure will be recognized within 12 hours, a standby duration of 24 hours is required. If the 12-hour requirement is not likely to be met, a standby of 24 hours after the detection of the fault is required.

For property protection (P) if the mains failure will immediately be recognized then a 24 hours standby is required, if not, then the required duration is 24 hours longer than the building may remain unoccupied.

11.0 WIRING

The satisfactory operation of a fire alarm system depends on the interconnection of its components. Some interconnections may have to function correctly for significant periods after being attacked by fire, e.g: cables to power supplies, control equipment and sounders.

Other cables must function when a trigger device operates, but are not needed after an alarm has been raised, e.g: cables to manual call points, smoke detectors and heat detectors.

Cables can therefore be classed in two groups:

1. Cables permissible if operation is not required during fire, e.g: Cables to manual call points, smoke and heat detectors.
2. Cables permissible if operation is required during a fire, e.g: Cables to power supplies, control equipment and alarm sounders.

While mineral insulated cables are preferable for fire alarm applications, the following cables can be used for the two groups:

Group 1

1. **MICC** to BS 6207: Part 1 with or without **PVC** sheath.
2. Cables complying with BS 6387 at least in categories **AWX** or **SWX** or **A** or **S**.
3. **PVC** – insulated to BS 6004 sheathed or non-sheathed with mechanical protection.
4. Rubber insulated to BS 5007
5. **PVC** single type **BK**, **BR** and **BU** to BS 6231.
6. **PVC** insulated **SWA** to **BS** 6346
7. Cross-linked polyethylene or hard ethylene-propylene rubber insulated **SWA**
8. to BS 5467
9. Polyethylene insulated PVC sheathed coaxial cable to the dimensional requirements of BS 2316: Part 3 but with a minimum of 16-strands/0.2mm diameter central conductor.
10. Cables designed for the detection of heat.

Group 2

Cables 1 & 2 in Group 1 may be used for Group 2 applications. All the other cables shown above may also be used provided that they are protected either by burying them within a wall and covering them with 12mm of plaster or equivalent, or protecting them from a significant fire risk by shielding them with a wall, partition or floor having a minimum demonstrate 0.5 hour fire resistance.

These requirements may in certain cases be reduced when included in areas of low risk or when covered by an automatic extinguishing system.

Certain cables may also need mechanical protection against impact, abrasion or rodent attack. As a guide, cables 1, 6 and 7 above will not need further protection but all others may in risk circumstances. BS5839 Part 1 gives full details.

Other types of cables can be used provided that their suitability can be clearly demonstrated.

Conductors carrying fire alarm power or signals should be separated from conductors used for other systems.

12.0 INSTALLATION OF CABLES

Cables should be installed in accordance with the good practices recommended in the latest edition of the IEE wiring regulations.

Connection to a mains supply should be via an isolating switch fuse reserved solely for the purpose. Its cover must be painted red and labelled **fire alarm – do not switch off**.

Conductor size should take voltage drop into account. In any case conductors should have a cross-sectional area of not less than 1 square mm or, if stranded, of not less than 0.5 square mm.

Where possible, cables should be routed through areas of low fire risk.

Cables installed in damp, corrosive or underground locations should be PVC sheathed. Where there is a risk of mechanical damage, cables should be protected accordingly.

Cables in cavities or voids should be separated from other cables by 300mm, unless enclosed in a conduit, ducting or trunking.

Screened cables complying to be BS 7629 can be run in duct or tray without segregation.

13.0 ROUTINE TESTING OF SYSTEM

The system should be regularly tested and serviced. BS5839 Part 1 makes the following recommendations:

Daily

- (i) Check that the panel indicates normal operation. If not, record any fault indicated in the event log and report the fault to a responsible person.
- (ii) Check that any fault recorded for the previous day has received attention

Weekly

- (i) Operate a manual call point or smoke detector to ensure the system operates properly. Each week a different detector should be checked.
- (ii) Check that the sounders have operated and then reset the system
- (iii) Check the battery connections.
- (iv) Complete the event log with details of date, time, trigger device tested and enter “**Routine Weekly Test**” the “**Action Required**” and reported to a responsible person

Quarterly

- (i) Check entries in the log book and take any necessary action.
- (ii) Examine the batteries and their connections.
- (iii) Operate a manual call point or smoke detector to ensure the system operates properly, checking that all sounders are operating.
- (iv) Check that all functions of the alarm control panel operate by simulating fault conditions.
- (v) Visually check that structural alterations have not been made that could have an effect on the siting of detectors and other trigger devices.
- (vi) Complete the event log with details of date, time, trigger device tested and “**Quarterly Test**” in the event sections. Any defects or alterations to equipment should also be entered.

Annually

- (i) Carry out an inspection as detailed for the quarterly inspection.
- (ii) Every detector should be tested **in situ**.
- (iii) All cable fittings and equipment should be checked to ensure that they are secure and undamaged.

SECTION B:

14.0 ANALOGUE ADDRESSABLE FIRE DETECTION SYSTEMS

Analogue Addressable Systems provide combined enhanced detection sensitivity and reduced false alarm potential to create a safer, trouble-free detection environment.

Analogue addressable systems should achieve levels of fire detection and protector which embrace the virtues of fast and accurate response and high levels of detection sensitivity with a significantly reduced false alarm potential.

The addressable system to meet the following:-

- The requirements of BS. EN54 Pt. 2 and 4: 1998
- Installer-friendly 'plug in' feature
- 2km maximum loop length
- Up to 120 devices per loop.
- **Other Required Features:-**
- Programmable sounder circuits direct from control panel.
- Capability to add manual sounder circuits, via loop alarm interface units.
- Sounders wired directly on to the detector loop
- Large capacity high intensity LCD-8 lines, with 40 characters per line
- Capacity for repeater panels on loop
- Facilities for on-site programming
- Password protected user and service menus
- Networking facility
- Dirty detector fault warning facility
- Day/night sensitivity adjustment capability
- Coincidence detection
- Pre-alarm facility
- Power supply remote option

14.1 Network Capability

The loop control panels should be capable of being interconnected easily to produce larger systems.

When a fire or fault condition is detected on any of the control units an event message is passed to all the other panels connected to the system. It should be possible to interconnect fire detection systems on larger sites to form a single-site network.

Within information from individual panels, available across the network, an overall fire plan, involving alerting or evacuating affected parts of the site can be implemented.

When a fire or fault condition is detected on any of the control units, an event message is passed on to all other panels connected to the system. Each panel will then display event information such as panel number, loop, zone/sector and address data. Alarm line operation across the network can be facilitated using zone and sector numbering.

Alarm sounder options

Alarm sounders can be connected to the system as follows:

- (i) On dedicated alarm lines, wired directly from the control panel. Four and eight separate alarm outputs to be provided in the two and four loop control panels respectively.

Each alarm circuit to be separately programmable to activate from any designated zone or zones of devices on the detection loop.

- (ii) Additional alarm lines to be connected to the system via alarm line interface units. Each unit to provide four programmable alarm line outputs and be capable of being positioned anywhere on the detection loop wiring.
- (iii) Where loop-wired sounders are used, these should be connected directly on the detector loop wiring. These units to be programmed either to sound a general alarm or be individually operated by a signal from any designated zone or zones of detection devices-hence offering a complete analogue addressable system on a single pair of wires.

Electronic sounders to give sound outputs complying with the requirements of BS5839 Pt 1: 1998. The sounders to be capable of giving various sound types.

14.2 Additional programmable features

The following additional features to be programmed into the system:

- address to zone number allocation (up to 128 zones)
- address to device type (e.g. detector or call point)
- zone, address, device type and sector text (24 characters each)
- zone or sector intermittent alarm pattern allocation
- 2 stage alarm timer
- zone or sector to auxiliary relay timed operation. Further relays may be added by using remote relay interface units.
- auxiliary input operation (e.g. silence/sound/evacuate etc)
- 40 characters of site text displayed by the panel in normal state, with the time and date.
- customer fire or fault programming
- double knock/coincidence
- day/night sensitivity
- adjustable detector threshold levels

15.0 SYSTEM FEATURES

Styled for the buildings of tomorrow

Information relating to the status of the system to be clearly indicated via the panel's alphanumeric 8 line, high intensity liquid crystal display.

15.1 1, 2 or 4 Loop options

The panels to be capable of being connected to either 1, 2 or 4 detector loops each loop being up to 2 km in length and 4 or 8 programmable sounder circuits, respectively.

Additionally, the panels to be capable of being networked together to provide even higher levels of detection and alarm system capacity. When networked, each panel to be configured to provide information relating to the entire fire detection system, thus enhancing the level of building safety.

15.2 Operation

Access level one controls to be positioned on the front of the panel, for ease of operation. Level two controls are to be concealed behind a key operated cover, and once exposed, they should enable the operator to interrogate the system's memory to obtain information on the location, status and progress of any fire incident.

Further levels of control, for example the disablement of, and reinstatement of detectors and zones, to be available via a security access code.

The system's memory to be capable of recording historical information relating to the minimum, maximum and current analogue levels received from any address, providing the facility for the constant monitoring of detector condition and a record of 'normal' fluctuations in the environment at each location, for simplification of routine testing and maintenance procedures.

15.3 Installation

Each panel to be supplied with address modules 1-60 for each loop. These are to be inserted into each appropriately numbered detector or call point on the system. Address modules 61-120 to be supplied separately to cater for systems with more than 60 addressable devices per loop.

15.4 Standard

The system to comply with BS EN54 Pt 2 1998 – Control and Indicating Equipment (CIE) and BS EN54 Pt 4 1998 – Power Supply Equipment (PSE)

16.0 SYSTEM OPERATION

16.1 Operational characteristics

The following is a brief summary of the main functions and the expected operational characteristics of the system.

- Adjustable pre and full alarm facilities

Adjustable pre and full alarm thresholds to be set for individual detector addresses.

Once a pre-alarm threshold has been reached, a signal to be sent to designated locations, alerting those responsible for system monitoring, that the potential for a fire incident may exist. When the full alarm threshold is reached, the system to automatically provide warning signals to pre-determined areas of the system, for purposes of facilitating orderly evacuation of those areas affected.

A day/night operation facility to be provided to give a desensitized level of detection during the day and full sensitivity during night time operation, without affecting immediate alarms from manual call points.

- Automatic detector fault facility

High and low- level fault thresholds to be indicated. If a device's analogue level drifts, over a period of time from its normal background value, a fault indication to be given at the panel, showing the address of the detector. The detector can then be inspected and serviced or replaced if necessary. This facility to be included to increase building safety through simplification of routine maintenance, and testing.

- Line extensions

Alarm and relay extension lines to be connected at any address on the analogue detection loop, using the appropriate interface.

- Repeater facility

The dedicated repeater panel to be either connected to the detection loop, or spurred directly from a panel, if preferred. The Repeater Unit to be supplied with an 80 character LCD and integral power supply unit.

- Enhanced detector addressing

Each system to be programmed to provide an address/detector indication for each device, which enables a 'DEVICE TYPE ERROR' indication to be displayed at the control panel in the event of a wrong device being fitted.

- PC control colour graphics and data acquisition facility

This add-on package, to feature a PC and monitor, complete with software and the origination of up to 12 site plans. Additional plans can be added as extras.

SECTION C: ANALOGUE ADDRESSABLE DETECTORS

17.0 ANALOGUE DETECTORS

The analogue photoelectric smoke detector is ideally suited to the detection of slow burning fires. It employs an infra-red light source and photodiode to provide early warning of a hazard. Smoke particles entering the detection chamber cause light scatter, which is detected by the photodiode. The detector to be resistant to false alarms caused by dust, insects, high humidity and draughts.

17.1 Analogue Ionization Smoke Detector

Particularly suitable for identifying clean burning fires. The detector to incorporate twin sampling chambers which provide enhanced stability and inhibit the potential for false alarms caused by changing environmental conditions.

Analogue Heat Detector to be capable of being configured by the control panel to operate either as a fast response, medium response heat detector, or a high temperature detector.

Common Mounting Base to be compatible with detectors (both analogue and conventional). The base to incorporate a secure locking tab and position indicator, facilitating the correct orientation of the detector for optimum viewing of the detector's LED.

18.0 ANALOGUE REPEATER PANELS

Analogue Addressable Repeater Panel

The repeater unit to incorporate a 2 x 40 character liquid crystal display, with the optional facility of an integral printer. Additional features to include own log, to receive and store information from the main panel, and an output to facilitate the addition of a mimic repeater panel. The standard unit to be surface or flush mounted.

Slimline Mimic Diagram (SMD)

The slimline machine is designed to augment the information provided by main or repeat panel.

The SMD helps to maximize alarm flexibility, whilst reducing system wiring to an absolute minimum.

The module is installed either as a sounder detector base or as a stand-alone wall or ceiling mounted unit. Either option is accommodated directly on the two wire detector loop.

The fully programmable SMD to allow alarm organization on a single sounder, zonal or general alarm basis.

The self-powered facility to allow up to 120 detection devices and up to 55 addressable sounders to be connected on to the loop wiring.

The SMD to have selectable tones, continuous intermittent or warble. To be used in systems designed to BS5839 Pt 1. The sound output to be rated at 93 dB.

Addressable Sounder

The loop wired addressable sounder is to be used with analogue addressable fire systems.

Installed either in conjunction with a detector or on a stand alone basis, the sounder is addressed and powered directly from the detector loop.

The unit to provide a sound level of 85 dBA, and offer continuous intermittent or warble sound types, all within the recommended BS5839 Pt 1 frequency.

Each analogue loop to have a maximum of 30 units.

19.0 LOOP INTERFACE UNITS

To help provide input/output signals from anywhere on the loop wiring. This device to enable automatic operation of building plant in the event of a fire or the interface with existing fire detection or fire extinguishing systems to be easily incorporated.

Alarm/power supply interface units to allow additional alarm lines to be wired from any loop location. Each unit to provide the facility for using four independent programmable alarm circuits (1A maximum per alarm line, 3A maximum load). Alarm lines to be controlled without the need to wire directly back to the panel.

Relay/power supply interface unit to provide four additional programmable relay contacts (5A, 30 VDC) to enable output signals for operating external equipment.

This unit to have a dedicated 240VAC supply and should be capable of being connected at any address location on the detection loops.

Interface units, loop maximums. A maximum of 3 alarm interfaces and 4 relay interfaces may be connected to each loop controller, with each loop controller controlling two loops.

As a two loop panel contains a single loop controller, a maximum of 3 alarm line interfaces and 4 relay interfaces may be connected to loops 1 and 2 or a combination of both. A four loop panel contains 2 loop controllers enabling a maximum of 3 alarm interfaces to be connected to either loop 1 or 2 with a similar number on either loop 3 or 4.

Short circuit isolator provides protection of the detection loop. This ensures that the remainder of the loop protected by the short circuit isolator arrangement continues to function should a fault occur.

Standard interface unit enables a spur, containing a maximum of 5 standard detectors, and an unlimited number of conventional call points to be connected to the detection loop. UP to 10 interface units may be connected to a loop. Conventional call points should be wired before conventional detectors on any spur circuit. They should not be mixed.

Input/Output interface unit provides both input and output signals directly on to the loop. Input signals from other fire protection systems can be displayed at the control panel. Output signals can be provided in order to operate plant shut down or door release equipment.

20.0 ADDRESSABLE BREAK GLASS CALL POINTS

The call point is addressed in a similar manner to the addressable detector bases, using the same set of address modules. There is no restriction on the number that may be used on a loop, up to a maximum of 120 address points. An LED indicator is incorporated as standard to confirm that the unit has operated.

Weatherproof break glass callpoint

For exterior applications, where required.

PART E

**TECHNICAL SPECIFICATIONS FOR THE
UPS EQUIPMENT**

PART E: TECHNICAL SPECIFICATIONS FOR UPS EQUIPMENT

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TECHNICAL SPECIFICATION FOR INSTALLATION OF UPS EQUIPMENT

PART 1: DESCRIPTION

1.0 **Introduction**

This technical specification describes an electronic Uninterruptible Power Supply (UPS) with a three-phase input and output, connected in series between the electrical distribution system and the load. This system is designed to operate in conjunction with the electrical distribution system of a building in view of supplying the load with a clean and uninterrupted source of power, regardless of disturbances on the upstream AC power system.

2.0 **System Operation**

Double-conversion (on-line) UPS, designed to operate in the following modes:

2.1 **Normal**

The UPS must continuously supply the critical loads.

The rectifier/charger draws alternating current (AC) from the normal AC input source and converts it into direct current (DC) for the inverter while simultaneously maintaining the battery charged.

2.2 **Battery Backup**

In the event of a failure of the normal AC input source, the critical loads are supplied by the inverter with power from the battery.

2.3 **Battery Recharge**

When the normal AC input source has been restored, the rectifier/charger again supplies the load via the inverter and recharges the battery. The inverter supplies current identical to that supplied during operation in normal mode.

2.4 **Via the Automatic Bypass**

In the event of UPS shutdown (voluntary or not), the automatic bypass ensures no-break transfer of the critical loads to the bypass AC source. Transfer back occurs automatically when the UPS has returned to normal operation.

2.5 Via the Manual Bypass (maintenance / test)

A manual-bypass switch to be used to isolate the inverter output and the automatic bypass for maintenance purposes. This facility to make it possible to repair the UPS without interrupting the load which remains supplied directly by the normal AC source.

2.6 Economy Mode (For Less Sensitive Loads)

On this mode, the UPS to operate as follows:-

The load is supplied by the bypass AC source via the automatic bypass. If the source fails or goes out of tolerance, the load is automatically transferred to the inverter without any interruption. No-break transfer back to the bypass AC source is carried out when the source returns to within tolerances.

3.0 Rectifier/Charger

3.1 Operation

A solid-state rectifier, fully microprocessor controlled, to be provided to convert the AC power from the normal AC input source into regulated DC power. A temperature sensor is to be provided for regulation as a function of temperature. The power is then filtered to supply the inverter and charge the battery. The rectifier/charger to be sized to support an inverter supplying full rated load and simultaneously charge the battery to 95% of its full capacity over a period equal to ten times the battery backup duration.

3.2 Input protection

The input of the rectifier/charger is to be protected by fuses.

3.3 Input current limiting

125% of the rated input current.

4.0 The Battery Bank

A battery bank shall be provided to give back-up of not less than 15 minutes.

5.0 The Inverter

5.1 Operation

The inverter to be made up of three inverter legs with IGBT transistors. To operate in free-frequency mode with pulse width modulation (PWM) and have a built-in transformer.

5.2 Input Voltage and Frequency

| | | | |
|------------|------|-------|------|
| Voltage : | 415V | \pm | 20% |
| Frequency: | 50Hz | \pm | 7.5% |

5.3 Output voltage and frequency

| | | | |
|------------|------|-------|------|
| Voltage : | 415V | \pm | 1.5% |
| Frequency: | 50Hz | \pm | 1% |

5.4 Thermal Overloads

The inverter to operate for a maximum time that depends on the current drawn, before shutting down to protect the various components against excessive temperature rise. The permissible operating times are listed below (where P.F. = 0.8):

- 2 hrs for 1.05 In to 1.1 In
- 30 minutes for 1.1 In to 1.15 In
- 10 minutes for 1.15 In to 1.25 In
- 3 minutes for 1.25 In to 1.35 In
- 1 minute for 1.35 In to 1.65 In.

5.5 Steady-state variations

+/- 1% in voltage for the rms values of the phase-to-neutral and phase-to-phase voltages.

5.6 Synchronisation range

0.25 to 2 Hz (0.5Hz as standard) adjustable in 0.25 Hz steps.

5.7 Dynamic performance

operation with battery (battery-backup mode):

+ 2% / - 2% for load steps of 100% to 0 and 0 to 100%.

operation without battery (normal or battery-recharge mode):

+ 2% / - 4 % for load steps of 100 % to 0 and 0 to 100%.

return to the 1% range (rms value) in less than 20 ms.

5.8 Performance with non-linear loads

All phase conductors to be sized for the rated current.

The neutral conductor to be sized for 1.5 times the rated current.

load crest factor: up to 3

output-voltage (Ph-Ph) distortion = 2 % maximum.

output-voltage (Ph-N) distortion = 3 % maximum.

6.0 Automatic Bypass

The automatic bypass to be sized for continuous operation under the following conditions:

6.1 Transfer without interruption to the load

The automatic bypass to ensure automatic, no-break transfer of the load to the bypass AC source when the control logic detects one of the following situations:

- a. the load is greater than the UPS rated power;
- b. battery backup time has elapsed and the bypass AC source is available;
- c. UPS failure.

6.2 Bypass source tolerances / transfer conditions

The bypass AC source MUST BE within tolerances and MUST accept no-break load transfers from the inverter if:

- a. voltage is within the range $U_n - 20\%$ to $U_n + 20\%$;
- b. frequency is within the personalised tolerances;
- c. phase shift between inverter and bypass-source voltages less than 3 degrees.

6.3 Manual Transfer

It must be possible to carry out a manual transfer from the UPS control panel.

6.4 Overload Capacity of the Automatic Bypass

Thermal overloads $< 1.35 I_n$: same overload capacity as the inverter (no derating for power factor)

Overloads $> 1.35 I_n$: 1 minute.

The short-circuit capacity ($\times I_n$) for 20ms at 415V to be $23/I_n$.

7.0 Maintenance Bypass

The UPS to be equipped with a maintenance bypass which may be used to transfer the load directly to the bypass AC source.

This to be carried out using three switches. Step by step help to be provided on the front panel of the UPS when the doors are open.

The manual-bypass switch to isolate the inverter output and the automatic bypass for maintenance purposes. Prior to transferring the load to the maintenance bypass, the UPS (or the parallel-connected UPS units) must be shut down.

8.0 Micro-processor-based control functions

The UPS control circuits to be microprocessor-based. All operations and parameters to be managed by internal software. Manual settings and potentiometers will not be accepted. Self-test and diagnostics circuits to be used to detect and isolate a fault, right down to the PC-board or wiring connections.

9.0 Control and Indication Panel

The UPS to be equipped with a control panel comprising system-status indications that may be used to control, monitor and display various system functions and parameters. The graphic display to be capable of displaying data in English, French, Spanish, Dutch, Italian, German, Swedish, Portuguese and, as an option, in Kiswahili.

9.1 System Parameters

The following parameters to be displayed:

- ☐ input voltage (phase-to-phase);
- ☐ input current per phase;
- ☐ bypass input voltage (Ph/Ph and Ph/N);
- ☐ bypass input frequency;
- ☐ inverter output voltage (Ph/Ph and Ph/N);
- ☐ inverter output current per phase;
- ☐ input, output and bypass frequency;
- ☐ percent load on inverter;
- ☐ inverter output power factor;
- ☐ inverter output in kVA and kW;
- ☐ DC voltage;
- ☐ crest factor;

- ☐ battery current (charge/discharge);
- ☐ battery backup time and remaining service life;
- ☐ temperature in the battery cabinet.

9.2 Mimic Panel

Five LEDs to indicate the status of the following elements:

- ☐ ☐ rectifier/charger;
- ☐ ☐ battery;
- ☐ ☐ automatic bypass;
- ☐ ☐ inverter;
- ☐ ☐ load.

9.3 Buzzer OFF button

This button to be provided to turn the buzzer OFF. However, a new malfunction will activate the buzzer again.

9.4 Complete Shutdown

Pressing the "complete shutdown" button to activate the following:

- ☐ shutdown of the inverter;
- ☐ opening of the static switch on the bypass;
- ☐ opening of the battery circuit-breaker;

It should be possible to activate the "complete shutdown" function externally via a relay contact in order to implement an EPO (Emergency Power Off) function.

10.0 Event Log

This PC board should have a capacity to store at least 500 events (alarms, UPS status information, etc.). It should also provide statistical information on the UPS parameters (battery backup time, number of transfers to battery power, number of transfers to the automatic bypass, current limiting, operating time on the inverter and on the bypass AC source).

It should be possible to access this information locally on the standard display or on a remote terminal via the JBUS protocol.

11.0 Optimised Footprint

It should be possible to position the UPS cabinet against a wall. It will be the contractor's due to give information on the cabling (size/type) required, and the floor cable trenches, cable trays, trunking etc. which may be required for efficient cable management and termination.

PART 2: INSTALLATION

1.0 Positioning

1.1 Layout of Cabinets on a False or Normal Floor

The attached diagrams show the required clearances for the UPS installations.

2.0 Cable Sizes

2.1 Electrical Parameters to Determine Cable Size for EACH UPS Unit will be as follows

2.1.1 Live Current

- Normal AC Source (415V): 45A for 30 KVA, 70A for 50 KVA and 105A for 75 KVA
- By-pass AC Source (415V): 45A for 30 KVA, 70A for 50 KVA and 105A for 75 KVA
- Battery 90A for 30 KVA, 140A for 50 KVA and 200A for 75 KVA

2.1.2 Cable Size (mm²)

- Normal AC Source (415V): 16mm² for 30 KVA, 25mm² for 50 KVA, 35mm² for 75 KVA
- By-pass AC Source (415V): 16mm² for 30 KVA, 25mm² for 50 KVA, 35mm² for 75 KVA
- Battery 2x16mm² for 30 KVA, 2x25mm² for 50 KVA, 2x35mm² for 75 KVA

3.0 Upstream Protection

Max permissible level : 23 In

Recommended circuit breakers are :

30 KVA

- Normal AC input: MG NS 63N 3P with STR23E trip unit.
- By-pass AC input: MG NS 63N 3P with STR23E trip unit

50 KVA

- Normal AC input: MG NS 100N 3P with STR23E trip unit.
- By-pass AC input: MG NS 100N 3P with STR23E trip unit

75 KVA

- Normal AC input: MG NS 125N 3P with STR23E trip unit.
- By-pass AC input: MG NS 125N 3P with STR23E trip unit

4.0 Downstream Protection

These protection devices ensure discrimination on each of the outgoers downstream of the UPS.

If the downstream protection indications are not observed and a short-circuit occurs on one outgoer, the result may be an outage longer than 20 ms on all the other outgoers.

The following circuit breakers are recommended – (on 415V A/C input):-

MG NS 100N with TM 80D trip unit.

PART 3: ARCHITECTURE

1.0 Single-UPS Configurations

1.1 Single UPS in normal mode

A single UPS is a modular unit made up of:

- ☐ two AC inputs
- ☐ a rectifier/charger
- ☐ a battery
- ☐ an inverter
- ☐ a static switch (automatic bypass)
- ☐ a manual bypass (maintenance bypass)

In normal mode, the load is continuously supplied by the rectifier and inverter modules. If the normal AC source fails, the static switch ensures no-break transfer to battery power (battery mode). The load is transferred to the bypass AC source only if the inverter fails or the battery has reached the end of its backup time.

1.2 Single UPS in Economy mode

This operating mode must be part of the UPS basic design.

It increases efficiency by using the bypass AC input as long as its power characteristics remain within strict tolerances (those of the load).

The system must automatically transfer to normal mode if the power characteristics on the bypass AC input go out of tolerances. The system must transfer to battery mode if the normal AC source is not available and the bypass AC source is out of tolerances.

1.3 Single UPS operating as a frequency converter

Operation as a frequency converter is similar to normal mode. However, because the frequencies upstream and downstream are different, bypassing is not possible from the AC input and the automatic and manual bypasses are therefore not included. A static switch ensures automatic, no-break transfer to the battery in the normal AC source fails.

2.0 Parallel Configurations

2.1 Modular Active Redundancy (2 modular UPSs)

In this type of configuration, parallel connection is intended to increase overall UPS reliability through redundancy.

The UPS units are identical and equally share the load. The load rating is less than or equal to the rating of a single UPS unit, such that if one unit fails, the other can continue to supply the entire load.

This type of redundancy is called 1/2.

Parallel connection must be carried out without interrupting the supply of power to the load because each UPS unit is equipped with a maintenance bypass.

2.2 Modular Parallel Connection for Capacity (3 or 4 units)

In this type of configuration, parallel connection (up to 4 units) is intended to increase the overall capacity and provide redundancy.

The UPS units are identical and equally share the total load, with some redundancy.

Example: a UPS configuration with 1/3 redundancy means that there are a total of three UPS units.

If one unit fails, the other two can still provide enough power for the entire load.

Parallel connection must be carried out without interrupting the supply of power to the load. The UPS system is made up of identical units with a common external maintenance bypass sized to handle the overall power rating.

2.3 Hot Standby Redundancy

In this configuration, one UPS unit backs up the other. If the downstream unit fails, the static switch transfers the load to the upstream unit without a break in the supply of power. This configuration offers the highest level of availability and protection.

PART 4: STANDARD FUNCTIONS

1.0 Cold Start

This function makes it possible to start the UPS even when the AC input source is absent. The power is supplied by the battery for a period determined by the battery charge level and the power required by the load. However, the battery discharge time should never exceed three times the rated backup time plus two hours.

2.0 Intelligent Economy mode

For less sensitive loads, the Economy mode options should be provided to reduce energy consumption. Under normal conditions, the load is supplied continuously by the bypass AC source via the automatic bypass. If the power supply fails or is no longer within tolerances, i.e. voltage outside the permissible $\pm 20\%$ in amplitude ($\pm 25\%$ as an option) or ± 2 Hz, the load is transferred to the inverter. The time required for transfer should be less than 15 ms.

3.0 Start on engine generator set

The following features should be provided for use with a standby generator:-

3.1 Charger walk-in lasting 6 to 10 seconds

This function (see fig. 19) avoids an excessive inrush current at start-up that could disrupt engine generator set operation.

3.2 Time Delay

This function, in conjunction with the walk-in, delays charger start. The purpose, in installations comprising multiple UPS units, is to avoid simultaneous starts that could disrupt engine generator set operation.

3.3 Power and Battery Charge Current Limiting

The UPS should be set to carry out one of the following limiting functions when an external signal is received via an auxiliary contact:

- ☐ limiting of the power drawn by the rectifier-charger in kVA. In this case, part of the power can be supplied by the battery for a period of up to 3 times the rated backup time.
- ☐ limiting of the charge current to 0 A, thereby stopping the charger to limit the power drawn during operation on an engine generator set.

3.4 Battery-Room Ventilation Fault

It should be possible to set UPS parameters such that when an external signal is received via an auxiliary contact, the rectifier/charger shuts down when a ventilation fault in the battery room is detected. Reset must be manual for the system to restart (safety function).

Advanced Battery Management

The UPS unit should optimise the service life of the battery and continuously maintain a high degree of operational security by ensuring the following functions:

- ☐ calculation of the true available backup time, taking into account the battery age, the temperature and the charge level;
- ☐ estimation of the battery service life;
- ☐ protection against excessive discharges;
- ☐ regulation of battery voltage depending on the temperature, which increases battery service life;
- ☐ limiting of battery current;
- ☐ automatic battery testing;
- ☐ battery discharge at programmable time intervals;
- ☐ battery status, used for preventive detection of battery faults;
- ☐ continuity of the battery circuit;
- ☐ protection against deep discharges depending on the discharge curves and battery isolation by the circuit breaker;
- ☐ progressive buzzer indicating the end of backup time;
- ☐ temperature monitoring used to:
 - ☐ regulate the charger voltage depending on the temperature in the battery room;
- ☐ warn the operator if the set permissible temperatures are overrun;
- ☐ enhance the accuracy of the battery backup time calculation carried out by the standard UPS function.

PART 5: COMMUNICATIONS FUNCTIONS

1.0 Standard Communication

1.1 Media contact card

This board to provide isolated relay contacts 250 V 5 A (6 x 2 changeover contacts) that may be used to activate indicating lights or buzzers to inform the user of the operating status of the UPS and the battery, for the following information:

- v load on UPS;
- v load on battery power;
- v load on bypass (maintenance position);
- v low-battery warning;
- v general alarm;
- v complete shutdown.

PART 6: OPTIONS

1.0 “BACKFEED” Protection on Bypass AC Input

The bypass AC input should be optionally equipped with a device to prevent flow of battery current upstream via the automatic bypass.

This device, placed upstream of the static switch, mechanically disconnects the bypass AC input when the load is transferred to battery power or if the bypass AC source fails. It ensures complete safety for persons servicing the installation upstream of the UPS.

2.0 THM (Total Harmonic Management) Filter

2.1 Total Control over Harmonics

The UPS should offer a complete set of solutions to control harmonic phenomena in low-voltage installations. The solutions to cover both harmonics reinjected upstream of the UPS and those created by non-linear loads.

These solutions should comprise:

- ☐ harmonic filters (see below "other harmonic filters):
- ☐ passive filters using inductors and capacitors;

- ☐ active filters, that calculate and compensate harmonics in real time:

SineWave active harmonic conditioners, the universal solution to eliminate harmonics at all points in low-voltage installations;

- ☐ on-site evaluation visits with guaranteed results for the proposed solution.

2.2 THM (Total Harmonic Management) built-in filters

The THM filters built into the UPS to use the SineWave active harmonic conditioner technology, optimised to provide the most cost-effective solution for each UPS.

The filter considerably to reduce the harmonic current reinjected into the distribution system, thus avoiding disturbances for loads. It is also a means to increase the power factor upstream of the UPS.

2.3 **Other harmonic filters**

In addition to built-in THM filters, the following harmonic-filtering should be provided:

- ☐ non-compensated filters to filter one or a number of fixed harmonics;
- ☐ compensated or dynamic filters, depending on the case, intended for use when an engine generator set supplies the UPS ;
- ☐ SineWave active harmonic conditioner, the most effective solution because the system automatically adapts to the harmonics drawn, whatever their spectrum. As a result, the electrical distribution system continuously supplies a perfect sinusoidal current wave.

3.0 **MultiSlot**

MultiSlot is a device which adapts the UPS to the communications protocols of the applications (computer and electrical) by combining three functions.

3.1 **Expansion Module for Communications Cards**

MultiSlot expands UPS communications capacity if the number of available ports or slots is not sufficient.

Two MultiSlot units can be connected in series to use up to seven communications cards.

3.2 **Protocol Converter**

MultiSlot converts Basic relay-contact or U-Talk serial communications to the ASCII, SNMP and JBus protocols.

For these two functions, MultiSlot uses a U-Talk/Basic acquisition card.

3.3 **Data Concentrator for parallel UPS systems**

MultiSlot monitors an installation made up of two UPS units. It provides an overall view by concentrating the data from the connected units.

4.0 **LED indications unit**

The LED indications unit gives remote indication of the main operating-status information on the UPS.

It supplies the following information via LEDs and a buzzer:

- ☐ load on battery power;
- ☐ low-battery warning;
- ☐ inverter off;
- ☐ general alarm.

It should be equipped with a battery to ensure operation even in the event of a power outage.

5.0 Battery Circuit-Breaker Enclosure

The battery circuit breaker should be housed in an enclosure.

6.0 External Manual Bypass Enclosure (for greater capacity)

An external Manual by-pass system, rated 450A (3-phase), should be provided across the UPS. The by-pass system should comprise a 450A TP/N manual change-over switch, 3 No. 450A TP MCCB to isolate manual supply, UPS supply, and load respectively. All the above devices to be enclosed in a common solidly bonded enclosure with adequate internal space for cable management and proper termination.

7.0 Software

A software should be included to control and monitor the electrical installation from a PC-type supervision station. To access the commands and measurements for the supervised UPSs, simply click the functions displayed on the screen.

8.0 External Surge Protection

An external surge protection device should be provided to offer surge protection in the ratio 5000:1.

9.0 Teleservice

Teleservice is a means to provide continuous remote monitoring of the UPSs via a modem built into the UPS and connected to a telephone line.

10.0 Voltage – Matching Transformer

This transformer is to be provided to:

- ☐ match the electrical distribution-system voltage to that of the UPS;
- ☐ create galvanic isolation between the load and the normal AC input source or to set up a suitable system earthing arrangement.

PART F:
TESTING, TRAINING, CONFIGURATION
AND DEMONSTRATION OF SCADA &
DISTRIBUTION SYSTEM
OPERATION

PART F: TESTING, TRAINING, CONFIGURATION AND DEMONSTRATION OF SCADA & DISTRIBUTION SYSTEM OPERATION

CONTENTS:

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| 2.0 | Scope | |
| 3.0 | Personnel | |

PART F: TESTING, TRAINING, CONFIGURATION AND DEMONSTRATION OF SCADA & DISTRIBUTION SYSTEM OPERATION

1.0 General

The purpose of testing, training, configuration and demonstration of the SCADA and distribution system operation will be:-

- i) To help achieve reliable use of the SCADA and distribution system.
- ii) To make it possible for maintenance and operation personnel to attend to system failures and breakdowns which may occur in as short a time as possible.
- iii) To bestow the maintenance and operation personnel with basic trouble-shooting techniques.
- iv) To carry out comprehensive testing of the entire processes of the system.
- v) To fully configure and integrate the system to make it user-friendly and interactive.
- vi) To prepare and submit operation and maintenance manuals.

2.0 Scope

The following shall be covered:-

i) PLC System

- System description
- Powering and Cabling
- Components
- Software Setups
- Troubleshooting
- Routine maintenance

ii) SCADA System

- System description and features
- Operation Instructions
- Hardware Setups
- Troubleshooting

iii) Distribution System

- System layout and description
- Operation of protective devices
- Communication characteristics
- Relationship with SCADA system
- Routine maintenance

3.0 Personnel

The trainers to be used by the suppliers of the SCADA and distribution systems must demonstrate their experience and education qualifications prior to being accepted. Minimum 5 years experience and University degree in their relevant fields will be required. The proposed trainers (a minimum of 2 people) must present their CVs with the bid.

As a guideline the training programme will be expected to last two weeks with an anticipated daily input of 3 hours from the trainers. One of the trainers would be a technical support engineer from the equipment manufacturers.

Manufacturer's Technical Support:

Technical support from the equipment manufacturers is a compulsory requirement. Among other things, the manufacturer's technical support engineer will be required to:-

- Review all the working drawings before they are submitted for the consulting engineer's approval.
- Draw a comprehensive testing and commissioning programme.
- Lead the testing and commissioning of the entire installation.
- Conduct comprehensive programming of the whole system to make it achieve the desired performance.
- Sign the commissioning report on behalf of the manufacturers and the contractor, and issue performance guarantee certification of the installation and all components, including a written 12 months Performance Guarantee.

The consulting engineer shall reserve the right to have the technical support engineer replaced, should they, in the opinion of the consulting engineer, be considered incapable of discharging their duties effectively, or do not have the required qualifications.

Signed.....
(for and on behalf of the Tenderer)

Date:

Official Rubber Stamp

PART –G

TECHNICAL SPECIFICATIONS FOR SOLAR PHOTO VOLTAIC BATTERY BACKED SYSTEM

TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC BATTERY BACKED SYSTEM

There are basically two solar PV systems: stand-alone and grid-connected.

Stand-alone solar PV systems work with batteries. The solar energy is stored in the battery and used to feed building loads after conversion from DC to AC power with a stand-alone inverter. These systems are generally used in remote areas without grid supply or with unreliable grid supply.

Grid-connected solar PV systems feed solar energy directly into the building loads without battery storage. Surplus energy, if any, is exported to the grid and shortfall, if any, is imported from the grid.

Typical Configuration for Solar Power System

- a) Supply 24V, 200 Wp Solar Panels Each 91No.
- b) Supply 6V, 1500 Ahr VLRA Gel Battery Blocks Each 60No.
- c) Supply Solar Support Structures for roof mounting
- d) Supply 80A Solar Charge Controller at 24V 12No.
- e) Supply Mains AC/Solar Interface - Control Panel
- f) Supply Maintenance Manuals including the Parts Catalogue for each of the units (Solar System, Interface/Control/Monitoring Unit) -
- g) Supply Consumable Spares for the system
- h) Local training (advisable)
- i) Supply of 15KW Grid-tie Solar inverter at 48/240V
- j) Submit shop drawings including layouts for array arrangement, solar PV dimensions, one-line diagrams showing functionality.

Panel output (Wp) capacity to be $\geq 90\%$ of design nominal power after 10 years and $\geq 80\%$ of design nominal power after 25 years.

Module frame Non-corrosive and electrolytically compatible with the mounting structure material

Termination box Thermo-plastic, IP 65, UV resistant

Blocking diodes Schottky type

Module minimum rated power The nominal power of a single PV module shall not be less than 74Wp.

RF Identification tag for each solar module Shall be provided inside the module and must be able to withstand environmental conditions and last the lifetime of the solar module.

Power output rating To be given for standard test conditions (STC). I-V curve of the sample module shall be submitted.

Compliance with standards and codes IEC 61215 / IS 14286, IEC 61730 Part 1 and 2, Salt Mist

Corrosion Testing As per IEC 61701

System components

The solar generator system will consist of the following:

- a) PV Solar Modules.
- b) Deep Cycling Maintenance free Battery.
- c) Charge regulator with programmable low voltage battery disconnect capability, and
- d) Voltage/Current Monitoring.
- e) Support Structure for PV array.
- f) Lightning Surge Protection.
- g) Installation materials and accessories.

PV System Specification

Solar Array

- a. The PV Array will be constructed on the basis of 24 V, 200W modules.
- b. The offered PV solar array capacity will be 15000Wp.
- c. Service life of PV Modules will be 20 years or better.
- d. Output Array voltage is 48V positive ground
- e. Offered PV Solar Module is defined by the following:
- f. Typical Power :TBD
- g. Minimum Power :TBD
- h. Voltage at peak power :34V
- i. Current at peak power :5.8A
- j. Open Circuit Voltage :43V
- k. Short Circuit Current :6.0A
- l. Cell Type :Crystal
- m. No. Of Cells in series: :72
- n. Dimensions :1618 x 814 x 35mm –to be confirmed by supplier.

Solar Power System

- a. Each offered PV module has a factory installed Bypass diode to protect the module against reverse current.
- b. Each module will have an indelible serial number inscribed on the module.
- c. Additional fringes of solar panels will be welded together as a means of securing them at the time of installation.
- d. j. The module will conform to IEC 61215 and its manufacture is ISO 9001 certified.

Solar Array Support Structure

- a. The support structure, mountings and fixing bolts/nuts are weather proof and corrosion resistant.
- b. The structure will be lightweight but strong enough to withstand Wind speeds of 120 km/hr.
- c. The supports will allow free air access to module rear
- d. It will allow tilt angle range adjustable by given steps
- e. Provision for cleaning solar panels will be afforded by the installation method.
- f. The stands of the structure will be bounded and connected to the building Earth.

The PV modules shall be mounted on fixed metallic structures having adequate strength and appropriate design, which can withstand the load of the modules and high wind velocities. The support structure shall be hot dip galvanized steel or aluminium.

Detailed specifications for the mounting structure are given below:

- i. Wind velocity withstanding capacity 150 km / hour
- ii. Structure material Hot dip galvanised steel with a minimum galvanisation thickness of 120 microns or aluminium alloy.
- iii. Bolts, nuts, fasteners, panel mounting clamps -Stainless steel SS 304

Mounting arrangement for RCC-flat roofs -With removable concrete ballast made of pre-fabricated PCC (1:2:4), M15

Mounting arrangement for metal sheet roofs -Mounting directly on the sheet metal, ensuring stability and wind withstanding capacity, or penetrating the sheet metal and fixing to the substructure, ensuring that the roof remains water proof and ensuring stability and wind withstanding capacity.

Mounting arrangement for elevated structures -The elevated structure has to be securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted

directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted on RCC surfaces.

Mounting arrangement for ground installations -With removable concrete ballast made of pre-fabricated PCC (1:2:4), M15; assuring enough ground clearance to prevent damage of the module through water, animals and other environmental factors.

Installation The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site.

Minimum distance between roof edge and mounting structure -0.6m

Access for panel cleaning and maintenance -All solar panels must be accessible from the top for cleaning and from the bottom for access to the module junction box.

Panel tilt angle North – south orientation with a fixed tilt angle of 11 – 13 degrees (depending on location), south facing.

The prospective Installer shall specify installation details of the solar PV modules and the support structures **with lay-out drawings and array connection diagrams**. The work shall be carried out as per the designs approved by the Consultant.

Battery

- a. Gel European made Deep Cycling Maintenance-free gas recombination sealed valve regulated batteries. Total Battery capacity is be 1500 Ah each.
- b. Operational life at 20°C will be better than 20 years.
- c. Self-discharge rate is less than 2%/month at 25°C.
- d. Allowable DOD will be 80%.
- e. Design DOD is assumed to be 50% in normal circumstances.
- f. Offered Battery will conform to IEC 896-2 tests and DIN 40 742 part 1 safety standard. IEC 896-2 cycles shall be stated.
- g. A suitable battery rack and container, suitable for indoor installation to be used.

Charge Controller

- a. A suitable Charge/Discharge controller to be offered to manage the battery charging process, disconnect the battery on a preset low voltage battery as well as affect interfacing functions with the solar panels, Batteries, Load and the Mains Alternating Current.
- b. The controller can send a start signal to the Mains AC if the battery voltage falls below a set value and stop the set when the battery voltage rises to a given value
- c. The offered Charge Controller shall fulfill all system requirements as laid out in these specifications.
- d. The Controller is able to handle up to 80Amps at 24V DC.
- e. The Charge controller incorporates a device to monitor the following :
 - i. Battery Voltage
 - ii. Battery Current
 - iii. Load Current
 - iv. Load Voltage
- f. The Controller has programmable functions that allow field setting of charge modes/alarm values:
 - i. Low voltage disconnect
 - ii. Low Battery Alarm

- iii. High Voltage Alarm
- g. The controller has high reliability and is estimated to work without fail for a sufficiently long period which is not less than 10 years.

Inverter

The solar inverter to be rated 15kW at 48VDC/240VAC 1No.

Alarms

- a) System and individual component failure is monitored by a dry contact alarm with an open/close circuit for the possibility of extending the alarms to a remote Network Maintenance Centre.
- b) The Alarm cable is to be laid inside a PVC conduit in the ground to the Rack inside the Equipment Room.
- c) The following alarms among others shall be provided:
 - i. Low Battery Alarm (the alarm will be initiated before the battery voltage has reached the nominal discharge value)
 - ii. High Battery Alarm (the alarm indicates the over-charging of the battery)
 - iii. No output from the solar array.

Connection to the Building Electrical System

- a. The AC output of the solar grid inverter shall be connected to the building's electrical system after the TANGEDCO service connection meter and main switch on the load side. The solar grid inverter output shall be connected to a dedicated module in the Main Distribution Board (MDB) of the building. It shall not be connected to a nearby load or socket point of the building. The connection to the electrical system of the building shall be done as shown in typical wiring diagram.
- b. For buildings or loads with diesel generator backup, the wiring of the solar grid inverter shall be such that the solar grid inverter cannot run in parallel with the diesel generator. This implies that the solar grid inverter must be connected to a distribution board on the grid side of the automatic or manual change-over switch as shown in typical wiring diagram.

Cables

- a. All cables shall be supplied conforming to IEC 60227/ IS 694 & IEC 60502/ IS 1554. Voltage rating: 1,100V AC, 1,500V DC
- b. For the DC cabling, XLPE or XLPO insulated and sheathed, UV stabilized single core flexible copper cables shall be used. Multi-core cables shall not be used.
- c. For the AC cabling, PVC or XLPE insulated and PVC sheathed single or multi-core flexible copper cables shall be used. Outdoor AC cables shall have a UV-stabilised outer sheath.
- d. The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.
- e. The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%
- f. The DC cables from the SPV module array shall run through a UVstabilised PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
- g. Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- h. All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm. The minimum DC cable size shall be 4.0 mm² copper. The minimum AC cable size shall be 4.0 mm² copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires. The following colour coding shall be used for cable wires:

- i. DC positive: red (the outer PVC sheath can be black with a red line marking)
 - ii. DC negative: black
 - iv. AC single phase: Phase: red; neutral: black
 - v. AC three phase: Phases: red, yellow, blue; neutral: black
 - vi. Earth wires: green
- i. Cables and conduits that have to pass through walls or ceilings shall be taken through a PVC pipe sleeve.
- j. Cable conductors shall be terminated with tinned copper end-ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and AC cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.

Earthing

- a. The PV module structure components shall be electrically interconnected and shall be grounded.
- b. Earthing shall be done in accordance with IS 3043-1986, provided that earthing conductors shall have a minimum size of 6.0 mm² copper, 10 mm² aluminium or 70 mm² hot dip galvanised steel. Unprotected aluminium or copper-clad aluminium conductors shall not be used for final underground connections to earth electrodes.
- c. A minimum of two separate dedicated and interconnected earth electrodes must be used for the earthing of the solar PV system support structure with a total earth resistance not exceeding 5 Ohm.
- d. The earth electrodes shall have a precast concrete enclosure with a removable lid for inspection and maintenance. The entire earthing system shall comprise non-corrosive components.

Surge Protection

- a. Surge protection shall be provided on the DC side and the AC side of the solar system.
- b. The DC surge protection devices (SPDs) shall be installed in the DC distribution box adjacent to the solar grid inverter.
- c. The AC SPDs shall be installed in the AC distribution box adjacent to the solar grid inverter.
- d. The SPDs earthing terminal shall be connected to earth through the above mentioned dedicated earthing system. The SPDs shall be of type 2 as per IEC 60364-5-53 Page 13 of 16

Junction Boxes

- a. Junction boxes and solar panel terminal boxes shall be of the thermo plastic type with IP 65 protection for outdoor use and IP 54 protection for indoor use.
- b. Cable terminations shall be taken through thermo-plastic cable glands. Cable ferrules shall be fitted at the cable termination points for identification.

Tools, Tackles and Spares

- a. The Installer shall keep ready stock of tools, tackles and essential spares that will be needed for the day-to-day maintenance of the solar PV system. This shall include but not be limited to, the following:
 - i. Screw driver suitable for the junction boxes and combiner boxes;
 - ii. Screw driver and / or Allen key suitable for the connectors, powerdistribution blocks, circuit breaker terminals and surge arrestor terminals;
 - iii. Spanners / box spanners suitable for the removal of solar PV modules from the solar PV module support structure;
 - iv. Solar panel mounting clamps;
 - v. Cleaning tools for the cleaning of the solar PV modules;

- vi. Spare fuses.

Caution Signs

- a. In addition to the standard caution and danger boards or labels as per the Regulations, the AC distribution box near the solar grid inverter, the building distribution board to which the AC output of the solar PV system is connected and the Solar Generation Meter shall be provided with a non-corrosive caution label with the following text: WARNING – DUAL POWER SOURCE EB & SOLAR
- b. The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.
- c. Caution labels as may be prescribed by TANGEDCO shall be fixed as per TANGEDCO specifications.

Metering

- a. An energy meter shall be installed in between the solar grid inverter and the building distribution board to measure gross solar AC energy production (the “Solar Generation Meter”). The Solar Generation Meter shall be of the same accuracy class as the TANGEDCO service connection meter or as specified by TNERC. Page 14 of 16
- b. The existing service connection meter needs to be replaced with a bidirectional (import kWh and export kWh) service connection meter (the “Solar Service Connection Meter”) for the purpose of net-metering. Installation of the Solar Service Connection Meter will be carried out by TANGEDCO and is not in the scope of the work of the Installer.

Documentation

The Installer shall supply the following documentation:

- i. System description with working principles.
- ii. System single line diagram.
- iii. Solar PV array lay-out.
- iv. Routing diagram of cables and wires.
- v. Data sheets and user manuals of the solar PV panels and the solar grid inverter.
- vi. A system operation and maintenance manual.
- vii. Name, address, mobile number and email address of the service centre to be contacted in case of failure or complaint.
- viii. Warranty cards.
- ix. Maintenance register.

Test Certificates and Reports to be Furnished

Test Certificates / Reports from IECQ / NABL accredited laboratory for relevant IEC / equivalent BIS standard for quoted components shall be furnished. Type Test Certificates shall be provided for the solar modules and the solar grid inverters to provide evidence of compliance with standards as specified in articles 4.0 and 7.0 of this Technical Specification. Customer reserves the right to ask for additional test certificates or (random) tests to establish compliance with the specified standards.

TECHNICAL SPECIFICATION OF SOLAR STREET LIGHTING SYSTEMS

DEFINITION:

A stand alone solar photovoltaic (SPV) street lighting system (SLS) is an outdoor lighting unit used for illuminating a street or an open area. It consists of photovoltaic (PV) module(s), compact fluorescent lamp (CFL), lead acid battery, control electronics, inter-connecting wires/cables, module mounting Pole including hardware and battery box. The CFL is fixed inside a luminaire which is mounted on the pole. The PV module is placed at the top of the pole at an angle to maximize incident solar radiation, and a battery is placed in a box attached to the pole. The module is mounted facing south, so that it receives solar radiation throughout the day, without any shadow falling on it. Electricity generated by the PV module will charge the battery during the day time. This system operates from dusk to dawn.

TECHNICAL SPECIFICATIONS & GENERAL SPECIFICATIONS:

1) DUTY CYCLE:

The system should automatically switch is ON at dusk, operate throughout the night and automatically switch is OFF at the dawn.

2) PV MODULE (S) :

- a. Both crystalline and thin film technology modules are allowed in the system. The PV module should have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 or IEC 61646 for crystalline and thin film PV modules respectively.

The manufacturer should produce the certificate for a higher wattage module, in case the certificate is not available for the offered PV module. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and process as that of the certified PV module. The certificate should be from an NABL or IECQ accredited Laboratory.

- b. The power output of the module(s) under STC should be a minimum of 74 Wp. Either two modules of minimum 37 Wp output each or one module of 74 Wp output should be used. In case of thin film technology PV modules, the specified values refer to the stabilized power output after the initial degradation.

The module efficiency should not be less than 12%.

- c. The operating voltage corresponding to the power output mentioned above should be 16.4 ± 0.2 V.

- d. The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.

- e. The terminal box on the module should have a provision for opening for replacing the cable, if required.

- f. Each PV module must use a RF identification tag (RFID), which must contain the following information:

- (i) Name of the manufacturer of PV Module.
- (ii) Model or Type Number
- (iii) Serial Number

- (iv) Month and year of the manufacture
- (v) I-V curve for the module
- (vi) Peak Wattage of the module at 16.4 volts
- (vii) I_m , V_m and FF for the module
- (viii) Unique Serial No and Model No of the module

Until March 2013, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions.

(g) A distinctive serial number starting with NSM will be engraved on the frame of the module. The distinctive number starting NSM will also be screen printed on the tedlar sheet of the module.

3) BATTERY

- (i) Lead Acid, tubular positive plate flooded electrolyte or Gel or VRLA Type.
- (ii) The battery will have a minimum rating of 12V, 75 Ah (at C/10 discharge rate).
- (iii) 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.

4) LAMP

- (i) The lamp should be 11 Watt compact fluorescent lamp (CFL) with 4 pins along with proper pre-heating circuit.
- (ii) The light output from the lamps should be around 900 ± 5 % lumens (for 11 W CFL).
- (iii) The lamp should be housed in an assembly suitable for outdoor use, with a reflector on its back.
- (iv) No blackening or reduction in the lumen output by more than 10%, should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).

5) ELECTRONICS

- (i) The inverter should be of quasi sine wave/ sine wave type, with frequency in the range of 20 - 30 KHz. Half-wave operation is not acceptable.
- (ii) The total electronic efficiency should be not less than 85 %.
- (iii) The idle current consumption should not be more than 10 mA.
- (iv) The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.

6) ELECTRONIC PROTECTIONS

- (i) Adequate protection is to be incorporated under no load conditions e.g. when the lamp is removed and the system is switched ON.
- (ii) The system should have protection against battery overcharge and deep discharge conditions.
- (iii) Fuses should be provided to protect against short circuit conditions.
- (iv) Protection for reverse flow of current through the PV module(s) should be provided.
- (v) Electronics should have temperature compensation for proper charging of the battery throughout the year.

7) MECHANICAL HARDWARE

- (i) A metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module(s) can be oriented at the specified tilt angle.
- (ii) The pole should be made of mild steel pipe with a height of 4 metres above the ground level, after grouting and final installation. The pole should have the provision to hold the weather proof lamp housing. It should be painted with a corrosion resistant paint.
- (iii) A vented, acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery with a provision of lock and Key.

8) OTHER FEATURES

- (i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery.
- (ii) There will be a Name Plate on the system, which will give:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Serial Number.
- (iii) Components and parts used in the solar street lighting systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.
- (iv) The PV module(s) will be warranted for a minimum period of 25 years from the date of supply and the street lighting system (including the battery) will be warranted for a period of two years from the date of supply. PV modules used in Solar Street Lighting System must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Twelve (12) years and 80% at the end of Twenty five (25) years.

The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.
- (v) Necessary lengths of wires/cables and fuses should be provided.
- (vi) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Street Lighting System. The following minimum details must be provided in the Manual:

PART H:

**TECHNICAL SPECIFICATIONS
FOR 2 X 200KVA SOUND-ATTENUATED
STANDBY GENERATOR SET INSTALLATIONS**

PART H: TECHNICAL SPECIFICATIONS

SUPPLY AND INSTALLATION OF 2X200KVA SOUND-ATTENUATED STAND-BY GENERATOR SET

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TECHNICAL SPECIFICATIONS

1. SCOPE OF WORKS AND SERVICES

- 1.1 The work covered by this specification includes the supply, delivery, installation, setting at work, commissioning to the satisfaction of the Project Manager/Engineer and maintenance for a period of twelve months, of one Diesel Engined Generating Set complete with all necessary auxilliary equipment and as indicated.

2. RELATED DOCUMENTS

- 2.1 The specification shall be read in conjunction with the Preliminaries, conditions of contract and any supplementary specification(s), schedule(s) and drawing(s) issued with it and enumerated in the invitation to tender. In the event of a discrepancy between this specification and any drawing issued with it or forming part of the contract the drawing shall be followed.
- 2.2 The words 'as indicated', 'where indicated', 'unless otherwise indicated' refer to items or requirements indicated elsewhere in the tender documents issued in connection with the contract e.g. on a drawing, in a supplementary specification or in Schedule 1.

3. REGULATIONS

- 3.1 The equipment shall comply with all relevant statutory standards and regulations current at the date of tender (unless otherwise indicated) and in particular the following:
- 1) I.E.E. Regulations for the Electrical Equipment of Buildings.
 - 2) Regulations under the Electrical Power Act.
 - 3) Factories Act.
 - 4) Any special regulations issued by the local Electricity or Water Undertakings.

4. STANDARDS

- 4.1 The equipment and all components shall comply with all relevant British Standards and Codes of Practice or other equal and approved standard specifications and codes. Where the equipment or part of it complies with other internationally recognized standards which are less stringent than British Standards or Codes of Practice, then the difference is to be stated in writing and must accompany the tender submission.

5. OPERATING CONDITIONS

- 5.1 The equipment and all components shall be suitable for operation in ambient conditions of 5° to 40° centigrade and up to 100% relative humidity in an unheated ventilated building.
- 5.2 All ratings of equipment and components shall be interpreted as site ratings and NOT sea level or other ratings. Details of the site are given in Schedule 1.
- 5.3 Sub Contractor is deemed to have visited the site and if unable to locate it to apply to Feradon Associates Ltd., P.O. Box 7375-00300, Nairobi, for directions to enable him to do so. The Sub-Contractor is deemed to have acquainted himself therewith as its nature, position, means of access, etc., and no claim in this connection will be allowed. No claim will be allowed for travelling or other expenses which may be incurred by the Sub-Contractor in visiting the site or preparing a tender for the contract works, and subsequent site visits to be called by the Architect during the contract period.

- 5.4 The set shall be capable of operating continuously and satisfactorily in a medium dust laden atmosphere as defined in BS 1701 and in accordance with BS 5514.

6. FUNCTIONAL REQUIREMENTS

- 6.1 As specified in Schedule 1, the set shall be used for emergency operation (standby power operation). It shall be possible to start, operate and stop the set manually independently of any automatic features.
- 6.2 Within the operating conditions specified (Section 5) the set shall be capable of starting and accepting full load within the shortest possible time and in any case not more than 10 seconds. Any special features included to achieve this shall be stated in Schedule 2.

7. PERFORMANCE

- 7.1 The output rating of the set in kVA, the voltage, the number of phases and the frequency shall be as specified in Schedule 1.
- 7.2 Within the operating conditions specified, each set, equipped with its standard air intake filters, shall be capable of delivering its rated output continuously at rated voltage and 0.8 lagging power factor and of delivering 10% in excess of the continuous maximum for a period of one hour in any 12 hour period.
- 7.3 The steady state voltage shall be maintained within $2\frac{1}{2}\%$ of the rated voltage under the control of the voltage regulator between the cold start ambient conditions and the maximum working temperatures, at any load from no load to 10% overload and from unity to 0.8 lagging power factor. After any change of load the voltage shall not vary by more than plus or minus 15% of the rated voltage and shall return to within plus/minus 3% within 3 seconds and to within plus/minus 2.5 % of rated voltage within 15 seconds. On starting the voltage overshoot shall not exceed 15% and shall return to within 3% in not more than 3 seconds.
- 7.4 The governing of the set shall be such that the steady load speed band shall not exceed 1% of rated speed. Sudden removal of the full load at rated frequency shall not cause the frequency to rise above 10% of rated frequency and it shall return to within 5 % of rated frequency within 3 seconds. The resultant steady state frequency shall return to 4% within 15 seconds. If full load is then reimposed the frequency shall not fall below 94% of rated frequency and shall return to 99% within 3 seconds and to the rated frequency within 15 seconds.
- 7.5 The cyclic irregularity of the set at full load shall not be worse than 1/150.
- 7.6 The deviation of the waveform of the voltage output from a pure sine wave shall not exceed the limits specified in BS 2613.
- 7.7 Radiated interference shall be suppressed to the limits specified in B.S. 800 and B.S. 833.

8. SET ARRANGEMENT

- 8.1 The set and its auxiliaries shall be mounted on a sufficiently substantial underbase. All items which must be held in correct relative alignment shall be located by means of dowels.
- 8.2 The set shall be designed and supplied for operation bolted to the floor on robust antivibration and shock absorbing devices.
It shall have adjusting screws for optimum setting and levelling and be so designed and installed that no appreciable engine vibration shall be transmitted to the floor or to any surroundings.

- 8.3 A new generator house will be constructed. The Sub-Contractor shall provide early enough full details of fixing requirements, and any modifications that may be necessary for the proposed house and foundation. Particularly, the Sub-Contractor appointed to supply the generator must confirm if the proposed house is adequate for the generator in terms of height, length, width and provision of natural ventilation. The Sub-Contractor will be responsible for the cost of modifying the generator house if he fails to provide the above information immediately.

The Sub-Contractor shall however provide means for bolting down the set. If the plinth provided is not sufficient the Sub-Contractor shall arrange to extend it to the Architect's satisfaction.

- 8.4 Bearings shall be suitable for operation over long periods without the need for replacement of the lubricant. Oil lubricated bearings shall be fitted with a visible oil level gauge.

9. DIESEL ENGINE

- 9.1 The engine shall be designed for satisfactory operation on fuel oil complying with BS 2869 Class D and the lubricating oils stated in Schedule 2.

- 9.2 The governor shall control the frequency with the limits stated in Section 7.4. Manual speed adjustment shall be provided over a range $\pm 5\%$ of the rated speed at any load.

- 9.3 The engine shall be totally enclosed, with forced lubrication from an integral pump having on the suction side a coarse strainer and on the delivery side a dual 'full flow' fine filter fitted with a changeover cock incorporating pressure by-passes, so that the oil flow to the engine is maintained if the filter should clog.

Alternatively a single filter of the self-cleaning type fitted with a by-pass relief valve and having the same filtration performance may be provided. The capacity of the lubricating oil system shall be sufficient to enable the engine to run continuously for 72 hours.

- 9.4 A filter fitted with by-pass relief shall be inserted in the fuel line immediately before the pump(s). The fuel filter element shall be incapable of passing particles larger than 5 micrometers. The fuel system shall be so arranged that fuel resulting from filter, pump or pipe spillage shall be incapable of entering the engine pump.

- 9.5 Air filters complying with BS 1701, Grade 'A' or Grade 'B' suitable for use in a medium atmosphere shall be fitted on the engine air intake(s).

- 9.6 No significant critical speed of the complete shaft system, including the generator, shall be within 15% of the rated speed.

- 9.7 A manually reset overspeed trip shall be fitted to stop the engine if its speed exceeds the rated speed by 15%. A mechanical trip is preferred but an electrical overspeed trip may be offered. Both types shall be equipped with a pair of contacts which close on operating of the trip. If the device is belt driven, at least two belts shall be provided and the drive shall be capable of carrying full load with one belt removed.

- 9.8 The set shall be arranged such that on shut-down the cooling water temperature shall not rise with residual heat so that the high water temperature lock-out operates (Section 23.1 (4) (a)).

- 9.9 The engine shall be naturally aspirated as indicated in Schedule No. 1.

- 9.10 Starting shall be by means of electricity supplied from a starter battery. The starter motor shall be of the axial type, de-energised by a device operated from the engine.

- 9.11 Suitable means shall be provided for turning by hand the engine main shaft and the associated generator to facilitate inspection and overhaul. A means of manual starting is to be provided as indicated in Schedule No. 1.

- 9.12 The engine shall be capable of being started from any crank position.

- 9.13 A thermostatically controlled 240 - volt immersion heater may be fitted in the engine lubricating oil sump to facilitate starting. The heating surface loading of any lubricating oil heater(s) shall not exceed 0.015 watt per sq. milimetre to avoid carbonisation of the oil.
- 9.14 An efficient exhaust silencer with adequate draining facilities shall be supplied, and as indicated in Schedule 1 shall be installed in the generator house with the exhaust discharge into the steel chimney. The exhaust silencer shall be so arranged that it may be readily relocated if required.

10. FUEL STORAGE TANK

- 10.1 The fuel storage tank shall be located close to the building and in the current Kenya laws relating to fuel storage close to buildings or be mounted on a plinth, which shall be properly fenced. Type of location is given in Schedule 1.

A minimum capacity of the tank shall be as per schedule 1. The tank shall be fitted with a hand operated fuel transfer pump and the necessary piping to allow the transfer of fuel from it to the daily service tank.

- 10.2 A three-way cock shall be fitted in the line from the tank to the engine to enable fuel to be supplied from a source other than the fuel tank. The position of the cock shall be clearly marked "TANK", "OFF" and "AUXILLARY".
- 10.3 The daily service fuel tank shall be equipped with a clearly visible plastic tube fixed vertical on its side to enable the level of the fuel in the tank to be seen readily. In addition to that it shall be supplied with drain, vent, overflow and inlet and outlet connections.

11. ENGINE INSTRUMENTS

- 11.1 The following instruments shall be provided:

- 1) a lubricating oil pressure gauge
- 2) a tachometer
- 3) a water thermometer
- 4) an exhaust gas pyrometer or thermometer mounted near the manifold.
- 5) lubricating oil thermometers on the inlet to and outlet from the engine, when a lubricating oil cooler is fitted.

12. COOLING SYSTEM

- 12.1 The engine shall be both air cooled and water cooled as indicated in Schedule 1.

13. AIR COOLING OF ENGINE

- 13.1 Cooling air for the engine and lubricating oil shall be provided by fan(s) mechanically driven from the engine. The cooling system shall be adequate for the total requirements of the engine when running on continuous full load and on 10% overload for one hour in accordance with BS 5514 and under the conditions of Section 5.

- 13.2 The engine shall be so designed that the cooling air discharges into or is drawn through a reasonable airtight ducted assembly enclosing the lubricating oil cooler, the cylinder barrels and the cylinder heads of the engine.

This assembly shall terminate in a flanged outlet to which trunking shall be readily attached, to enable hot air from the cooling system to be ducted and discharged outside the building together with exhaust.

Belt driven fans shall have at least two belts and the drive shall be capable of transmitting the full load with one belt removed. The cooling air temperature shall be controlled so as to maintain a safe working temperature of the cylinder head(s) and the engine shall shut down if the maximum is exceeded (see section 22.1 (4) (b)).

14. WATER COOLING OF ENGINE

- 14.1 A radiator of the air blast type shall be provided. It shall either have separate section for water and for lubricating oil or be arranged for jacket water cooling only.
- 14.2 Belt driven fans shall be provided with at least two belts and the drive shall be capable of transmitting the full load with one belt removed.
- 14.3 Circulation of the jacket water and lubricating oil through the respective radiator sections and/or heat exchanger shall be by means of pumps mechanically driven by the engine. Belt driven pumps shall be provided with at least two belts and the drive shall be capable of transmitting the full load with one belt removed.
- 14.4 An easily visible flow indicator provided with contacts shall be fitted in the water outlet from the engine; the contacts shall close in the 'no-flow' condition and shut down the set.

Alternatively in thermosyphon systems and scaled or pressurised radiator systems the flow indicator may be dispensed with providing the engine shuts down by the operation of the high temperature or low oil pressure safety devices in accordance with Section 22.1.

- 14.5 A thermostatically controlled diverter valve shall be inserted in the engine water discharge pipe with a return to the circulating pump section, to maintain the circulating water at the optimum temperature irrespective of load. Alternatively a thermostatic by-pass will be accepted.
- 14.6 A radiator makeup/expansion tank, fitted with float control inlet shall be provided. If a sealed or pressurised unit is offered the tank may be dispensed with.
- 14.7 Where indicated in Schedule 1 provision shall be made on the radiator framework to permit the attachment of ducting for the discharged air.
- 14.8 A thermometer shall be mounted near the cylinder head(s) to indicate water temperature. Where a lubricating oil cooler is fitted, inlet thermometers shall be mounted at the oil to and outlet from the engine. Alternatively, thermocouples may be provided at all thermometer positions and taken out to an instrument panel.
- 14.9 Adequate drains shall be provided at low points in the water and lubricating oil systems of the radiator and, where applicable, of the heat exchanger.

15. ALTERNATOR AND EXCITER

- 15.1 The alternator shall be directly coupled to the engine and be sized such that it will accept the maximum output of the engine including overload.
- 15.2 Where the alternator is of the rotating armature type a slipring shall be provided for the neutral.
- 15.3 The alternator shall be capable of operating within the range of $\pm 5\%$ of the nominal voltage according to the setting of the automatic voltage regulator.
- 15.4 Three-phase machines shall be star connected, and a diagram showing the terminal markings and phase rotation shall be provided in the terminal box. Cables connecting the machine winding and machine terminals shall not have a higher derating factor for temperature than the windings.
- 15.5 Machines shall be both clean protected and drip proof. Overall drip proof covers will be accepted.

15.6 The insulation shall comply with BS 2757 excluding Classes Y and A. The insulation shall have an oil, moisture and fungus proof finish, with a surface which will not retain dust or condensation, it shall be possible to put the set in service after long periods, in unheated storage without the necessity for drying up the insulation.

15.7 The alternator shall be capable of withstanding a short circuit for three seconds when under the control of the automatic voltage regulator.

16. EXCITATION

Alternators using exciters with commutators shall be designed for an excitation voltage of full load of not less than 50 volts unless prior approval is given.

16.2 Where rotary exciters are fitted they may be direct coupled or driven by Vee-belts or chains. The speed of belt or chain driven exciters shall not be within 5% of a multiple of the alternator speed. Vee belt drive shall have at least two belts and shall operate satisfactorily if one belt is removed. Special attention shall be given to ensure satisfactory commutation, brush life and freedom from voltage drift. The neutral and running, positions of the brushes shall be clearly marked.

16.3 If static excitation and/or control system are offered, a description of the equipment and method of operation shall be submitted for approval.

17. ELECTRICAL CONTROL PANELS

A control panel shall be provided to accommodate the following:

- 1) An automatic voltage regulator
- 2) A hand field regulator and a 'HAND AUTO' switch
- 3) An alternator field switch
- 4) Meters (Section 20)
- 5) A neutral earthing link
- 6) A change - over - Contactor

18. AUTOMATIC VOLTAGE REGULATOR

The automatic voltage regulator shall be of a type which will maintain its adjustment for long period without attention. It shall be provided with an adjustment for setting the level of the controlled voltage to within $\pm 5\%$ of the nominal voltage.

19. HAND FIELD REGULATOR

19.1 The hand field regulator shall give stable control of the voltage from 90% of the normal voltage at no load when cold to normal voltage at 10% over-load when hot, under the specified operating conditions.

If a static excitation system is offered which does not permit the use of a hand field regulator this shall be stated in the Tender together with performance details.

19.2 If the hand field regulator must be left in a precise position when the set is under the control of the automatic voltage regulator then this position shall be clearly marked.

20. METERS

The following meters shall be provided. They shall comply with BS.89, Table 7.

- 1) One maximum demand ammeter in each line
- 2) One voltmeter, and a selector switch to read line to line and line to neutral voltages.
- 3) A frequency meter
- 4) A field ammeter
- 5) Maximum KVA meter and Kilowatt hour meter.

21. AUTOMATIC STARTING PANEL

- 21.1 Automatic starting panel shall be provided which shall contain all necessary equipment for controlling the automatic starting and stopping of the set, lubricating oil priming (if necessary), auxiliaries, fault warnings and shut-downs. All faults, warnings and shut-downs shall be separately indicated. There shall be test facilities for indication lamps etc., preferably by means of a single test button.
- 21.2 Means shall be provided for isolating all supplies to the starting panel either by an isolating switch or by withdrawable fuses. For external use, a 24 volt battery supply from fused outlet terminals shall be provided only when the engine is running and in service (see Section 28.3).
- 21.3 The starting and control circuits shall be rated at 2 amps at the control circuit voltage.
- 21.4 A selector switch shall be fitted having three positions as follows:
 - 1) 'Local' In this position it shall be possible to start and stop the set by push buttons mounted on the panel.
 - 2) 'Remote' In this position the set shall be capable of being started and stopped from a remote circuit.
 - 3) 'Off' In this position all the automatic features shall be inoperative.
- 21.5 When the set is stopped other than under lock-out conditions it shall be self resetting, ready for the next start.
- 21.6 In the 'Off' position (Section 2.4 (3)) or with the automatic equipment disconnected, the set shall be suitable for starting by manual means, e.g. by cranking or direct operation of the starter solenoid.
- 21.7 All switches and push buttons shall be clearly marked to indicate their function.
- 21.8 It shall be possible to operate the "Start and Stop" buttons and the three-position switch and to see the "Set Failure" indications without opening the panel doors.

22. AUTOMATIC CHANGEOVER CONTACTOR UNIT

- 22.1 Where the functional requirements (see Section 6) indicate the set is to be used for automatic standby or mains failure duty a contactor unit shall be provided which on failure of the normal electricity supply will automatically initiate the starting of and effect the transfer of load to the standby generator.
The unit shall be incorporated in the Automatic Starting Panel (see Section 21).
- 22.2 Where failure of the normal supply is referred to, it shall be defined as the complete loss of voltage or the falling below 85% of the normal voltage between any two lines or line and neutral.
- 22.3 The power circuit shall consist of two contactors feeding the distribution branch to which the load will be directly connected. One contactor shall control the normal supply, the other the standby supply, they shall be electrically and mechanically interlocked so that they cannot both be closed at the same time.

- 22.4 On the failure of the normal supply (Section 22.2) the unit shall operate in the following manner:-
- 1) After a delay, adjustable from 0 to 5 seconds (to avoid operation by a transient dip in voltage) a signal shall be given to start the standby generating set.
 - 2) On receipt of a signal from the standby generating set that it is ready to take the load, and providing that the failure of the normal supply still persists, the normal supply contactors shall open and the standby contactor shall close. If the normal supply has been restored before the changeover has taken place, the contactors shall not operate and the starting relay contacts shall open to initiate the shutting down of the standby generating set.)
- 22.5 When the standby supply is in operation and the normal supply is restored and remains within 10% of rated voltage on all phases for a pre-set time (adjustable upto to 30 seconds) the standby contactor shall open and the normal supply contactor shall close; the starting relay contacts shall then open to shut down the standby generating set.
- 22.6 Provision shall be made so that automatic return to normal supply can be prevented if required (Section 22.9 (s).
- 22.7 Once a start signal has been sent to the standby generating set the engine starting sequence shall be allowed to continue until the set is ready to take the load before a stopping signal is sent.
- 22.8 By the additional external connections the following facilities shall be available:-
- 1) Remote starting of the standby generating set and transfer of the load to it.
 - 2) Restoration of the normal supply on failure of the standby generating set.
- 22.9 Each switch shall be labelled with its duty and each position shall be marked. The following switches shall be provided and fitted:-
- 1) A Contactor Control Switch with make before break contacts and 'Hand' and 'Auto' positions. In the 'Hand' position the unit shall be controlled by the 'Contactor Hand Control Switch' (Section 23.9 (2). In the 'Auto' position the unit shall operate automatically irrespective of the position of the 'Contactor Hand Control Switch'.
 - 2) A Contactor Hand Control Switch with 'Standby' and 'Normal' positions. This switch shall enable either contactor to be closed when the 'Contactor Control Switch' is in the 'Hand' position.
 - 3) An Auto Return Switch having 'On' and 'Off' positions. In the 'On' position the return to normal supply shall be automatic when the normal supply is restored. In the 'Off' position the standby supply contactor shall remain closed when the normal supply is restored.
 - 4) Contactor By-Pass Switches shall be provided to enable the essential load circuits to be served direct from the normal supply to enable the generator and/or the control equipment to be serviced. The by-pass switches shall be provided with a suitable and conspicuous label warning against leaving the generator in the disconnected position.
- 22.10 Indicating lamps or illuminated panels shall be provided on the front of the panel. They shall be appropriately labelled, easily visible and shall give the following information:
- 'Normal Supply Available'
 'Standby Supply Available'
 'Normal Supply in Use'
 'Standby Supply in Use'
- 22.11 A push button labelled 'Test' shall be provided to enable a failure of normal supply to be simulated. If the button is pressed and released the equipment shall complete the starting sequence, and when the set is ready to take load it shall be shut down. If the button is held depressed the equipment shall change over to the standby supply when the set is ready to take load.
- 22.12 The control circuit supply will be either 12 volts d.c. or 24 volts d.c. depending upon the starting battery and charger (see section 28).

No current shall be drawn from the control supply when the unit is accepting the normal power supply.

23. LOCK-OUT

23.1 The set shall stop and lock out to prevent further starting when:

- 1) It fails to start when the electric starter motor has been in operation for 20 seconds under automatic start conditions;
- 2) The lubricating oil pressure falls to a value at which it would be unsafe to continue running the engine;
- 3) The cooling water does not flow, where the engine is fitted with a visible flow indicator on the cooling water system.
- 4)
 - a) in water cooled engines the cooling water temperature exceeds a predetermined limit
 - b) in air cooled engines the cylinder head temperature exceeds a safe maximum
- 5) The overspeed trip has operated.

23.2 Failure of the circuits concerned in sub-sections 23.1(2) to 23.1(5) shall not cause a set to shut down.

24. FAULT INDICATION

Each lock-out detailed in Section 23.1 shall be indicated by a lamp on the panel together with an indication of the fault causing the shut-down. The fault warning lights shall be set to operate before the lock-out.

25. LOCK-OUT REMOTE INDICATION CIRCUIT

Where indicated in Schedule 1, an auxiliary circuit suitable for 2 amps 50 volts d.c. and 1 amp 250 volts a.c. shall be provided with a contact which is open when the set is available and closed when it is locked-out. This lock-out circuit shall be connected to terminals for the connection of external wires to provide remote indication of lock-out.

26. LOCK-OUT RESET

Reset of the lock-out shall be by hand.

27. FIRE SERVICE TERMINALS

27.1 Where indicated in Schedule 1 an emergency stop circuit shall be provided with terminals marked FS1 and FS2. These terminals shall be initially fitted with a link and are for optional connection to a remote fire switch. Opening of this circuit shall stop the set if it is running, and as long as the circuit remains open the set shall be incapable of being started by 'Hand' or 'Automatic' control. This circuit shall be self-resetting so that the set is available for automatic starting when the circuit is restored.

27.2 Terminals shall be provided in the battery circuit for optional connection to a fire service battery switch. Opening of this switch shall isolate the control circuits from their supply.

28. STARTING BATTERY AND CHARGER

28.1 The battery shall be either 12 or 24 volts and capable of withstanding the loads imposed upon it by its specified duties. It may be of lead-acid or alkaline type and shall be of sufficient capacity for four starts in succession once in an eight-hour period. Auxiliary circuits connected to the battery shall be protected by fuses.

- 28.2 The battery shall be used to supply any automatic starting and control equipment, and relay operation shall not be impaired when the battery is supplying current to the starter motor.
- 28.3 A single phase supply for battery charging shall be available from the set when it is in service, and where circumstances permit, from an external supply (Section 17(9)).

A charger shall be provided which will recharge the battery after engine starting and maintain it in a charged condition when the set is standing or is in service. It shall also supply the load of any automatic starting and control equipment, and any additional load upto 24 volts level when the set is running and in service. An alternative quick charge rate shall be provided. The charger shall be fitted with an ammeter to measure the charge and discharge current excluding the starter motor current.

29. WIRING

Power cables and small wiring cables interconnecting major components shall be of the heat and oil resistant type and shall be metal sheathed or run in metal ducts or metal conduit, which shall be flexible where appropriate. All cabling and small wiring shall be coded and terminated with lugs or be soldered; the terminations shall be clearly marked with the numbers and letters of terminals to which they are connected. Terminals shall be numbered or lettered, easily accessible and fitted with individual insulating barriers or adequately spaced barriers shall be fitted to separate control terminals from power wiring terminals.

30. EARTHING AND EARTH FIELD

- 30.1 All metal work housing electrical equipment shall be bonded to a brass earthing terminal of not less than ISO bolt M10.
- 30.2 Where indicated in Schedule 1 an earth field is to be provided suitable for requirements.

31. CONTACTORS

Contactors shall have magnetic circuits designed for a.c. or d.c. operation and shall be rated in accordance with BS 775 for Uninterrupted Duty and Utilization Category AC4. Four-pole contactors shall be fitted for three-phase equipment and two-pole contactors for single phase equipment. Main and auxiliary contacts shall be silver faced or better.

32. RELAYS

- 32.1 Relays shall preferably be of the sealed type mounted in approved plug-in bases with spring loaded retainers but if this is not practicable they shall be mounted on individual sub-bases and wired so that easy access is obtained to soldered connections. Unsealed relays shall be enclosed in individual or common dust protecting cases.
- 32.2 Time delays, if of the pneumatic type, shall operate on filtered air. The thermal type of time delay relay will not be accepted.

33. FUSES

Fuses shall comply with BS 88, category of duty AC 46, fusing factor class A1. A spare fuse cartridge for each pole shall be mounted inside each equipment.

34. RECTIFIERS AND CAPACITORS

- 34.1 Rectifiers and capacitors shall be suitable for any transient voltages likely to be encountered during the operation of the equipment and for the internal operating temperature of the enclosures at the specified maximum external ambient temperature.
- 34.2 Electrolytic capacitors will not be accepted unless approved for a specified purpose.

35. ENCLOSURES FOR ELECTRICAL AND CONTROL EQUIPMENT

Enclosures for electrical and control equipment shall be drip proof and dust protecting, with adequate front and rear access as necessary for maintenance and repair. Special attention shall be given to the method of construction and to the mounting of the components to minimize the effect of vibration. Diagrams of connections in durable form shall be mounted inside the enclosures.

36. GUARDING

All live and moving parts shall be adequately guarded to prevent injury to personnel.

37. INFORMATION PLATES

A non-ferrous metal rating plate shall be fixed on the front of the alternator control panel door, giving the following information:

| | | |
|-------------------|-------|-----------------------|
| Continuous output | | KVA at 0.8 p.f. |
| Voltage | V | -phase - wire |
| Frequency | Hz | Speed rev/min |
| Control Supply | v.d.c | Maker's Serial Number |
| Year of supply | | |

38. DANGER PLATES

Since this set is automatically started a reversible plate 400 x 250 mm shall be fixed by screws in a prominent position on each side of the set. One side of the plate shall be blank and painted the same colour as the set; the other side of each plate shall be signal red (BS 2660, colour 0-006) with the following inscription in white.

**DANGER
THIS MACHINE IS AUTOMATICALLY CONTROLLED
DO NOT WORK ON IT UNTIL
STARTING EQUIPMENT IS ISOLATED
OR DISCONNECTED AND CAUTION
NOTICES ARE DISPLAYED**

39. TROPICALISATION OF COMPONENTS

All components shall be fully tropicalised and protected against mould growth.

40. FINISH

- 40.1 All ferrous metal works shall be either painted or processed to give a rust proof coating.
- 40.2 Ferrous metal work to be painted shall first be either shot blasted or thoroughly wire brushed to remove all scale and oxide and immediately given one brushed coat or two sprayed coats of primer. After not less than 4 hours, one brushed or two sprayed undercoats followed by one brushed or two sprayed finishing coats of heat and oil resisting quality paint shall be applied.
- 40.3 Successive coats of paint shall be of slightly differing shades. Interior surfaces of electrical equipment enclosures shall be finished white and all external surfaces shall be finished grey (BS 2660, colour 9-097). Engine crank cases shall not be painted internally unless the paint is resistant to the lubricating oil.

41. MAINTENANCE MANUAL

- 41.1 Upon Practical completion of the Works the Sub-Contractor shall furnish to the Engineer four copies of a Maintenance Manual relating to the installation forming part of all of the Works.
- 41.2 The Manual shall contain full operating and maintenance instructions for each item of equipment, plant and apparatus set out in a form dealing systematically with each system. It shall include as may be applicable to the Sub-Contract Works the following and any other items listed in the text of the Specification hereinafter.
- 1) System Description
 - 2) Plant
 - 3) Valve Operation
 - 4) Switch Operation
 - 5) Procedure of Fault Finding
 - 6) Emergency Procedure
 - 7) Lubrication Requirements
 - 8) Maintenance and Servicing Periods and Procedures
 - 9) Colour coding Legend for all Services
 - 10) Schematic and wiring Diagrams of Plant, Apparatus and switchgear.
 - 11) Record Drawings, true to scale, reduced to International A4 size.
 - 12) Lists of Primary and Secondary Spares.
- 41.3 The Manual is to be specially prepared for the Contract Works, and Manufacturers' standard descriptive literature and plant operating instruction cards will not be accepted for inclusion unless exceptionally approved by the Engineer. The Sub-Contractor shall, however, affix such cards, if suitable, adjacent to plant and apparatus. One spare set of all such cards shall be furnished to the Engineer.
- 41.4 Manuals shall be printed on good quality paper preferably International A4 size and shall have stiff covers of durable material. The maker's name and the rating of the set shall appear on the front covers.

42. DRAWINGS

The Sub-Contractor shall provide to the Architect four sets of the following drawings:-

- 1) Where indicated, a building drawing showing details of cable entries, pipe entries and ducts required, and the exhaust system.
- 2) A general arrangement drawing showing the principal dimension and weight of the set.
- 3) A general arrangement of the diesel engine.
- 4) A general arrangement of the alternator and exciter showing terminal markings, polarity and phase rotation.
- 5) A general arrangement of the electrical control panel(s).
- 6) A schematic and wiring diagram of the electrical control panel(s).

43. WORK TESTS

- 43.1 The set shall be tested as a unit at the manufacturers works (or else where by agreement) for output and performance generally in accordance with the requirements of BS 649 and BS 2613. The Engineer shall be given adequate notice in writing of the date and time of the works tests and he, or his representative shall if he so desires, be present at such tests and be given all reasonable facilities for his own inspections during the course of the tests.

- 43.2 Whether or not the Engineer or his representative attends the tests, he shall be furnished by the Sub-Contractor with copies of all relevant test certificates.

44. COMMISSIONING

- 44.1 The Sub-Contractor shall include for fully commissioning the set and its control equipment and, for the purpose of the required tests, shall provide all necessary instruments, tools, fuel and lubricating oil.
- 44.2 The following tests and checks as applicable shall be carried out by the Sub-Contractor in the presence of the Architect or his representative.
- 1) Check that the main frame is level in all directions, Engine and generator shafts are in proper alignment and the vibration absorbing devices are properly installed and located.
 - 2) Check water and sump oil levels and that the water jacket and radiator heaters (if fitted) are in working order.
 - 3) Check the battery electrolyte level and the specific gravity.
 - 4) Examine the containers in which the fuel and lubricating oils were delivered and check that the types and grades of oils are as recommended for the units.
 - 5) Ensure that sufficient fuel oil is in the tank for a two hours test run.
 - 6) Check that all radiator and engine block water drain points are free from sludge and other blockages.
 - 7) Check engine bolts, main drive coupling, valve clearances, fuel pump settings, governor settings, pipe line connections, water hose, exhaust couplings, flexible pipework etc., and where a separate cooling water tank is fitted, that the water level is satisfactory and the ball valve and over flow work.
 - 8) Check all outgoing connections on the generator and at the control panel. All lugs for principal connections shall have clean and bright contact surfaces. A suitable abrasive material shall be used where necessary.
 - 9) Check access panels and doors for proper opening and closing and for the functioning of any interlocks fitted.
 - 10) With the set isolated from the main supply and the selector switch in the 'manual' position, start the engine by means of the 'start' push button and allow it to run upto normal speed. Check that during the time the engine starter motor is in operation, the mains battery charger is automatically switched off to avoid its being overloaded by the reduction in voltage across the battery. Where a battery charging dynamo is fitted, Check that the main battery charger is disconnected by the operation of the auxilliary Sub- Contactor during the time the engine is running.
 - 11) Check instruments and gauges for normal operation and response and that the generator voltage is being maintained within the prescribed limits, making due allowance for no load conditions. Compare the reading of the frequency meter with that of the engine tachometer, where both are fitted.
 - 12) Stop engine by turning selector switch to 'off' position and verify that generator contactor opens at between 95%. and 85% of normal voltage.
Re-check water and oil levels.

- 13) Turn selector switch 'to auto' position. Disconnect the sensing circuit supply and check that the set starts, the mains contactor opens, and the generator contactor closes in correct order. Reconnect the sensing circuit to verify that the Engine stops on the restoration of the mains supply and the contactors operate correctly.

Check voltage sensing and time delays on each phase in turn and also that the push buttons for mains failure simulation and Engine stopping operate correctly.

NOTE: Running of the engine for any length of time under no-load conditions is undesirable and tests calling for such operation should be carried out in as short a time as possible consistent with thoroughness.

- 14) Operate the necessary isolators and switches to put the set on standby for the essential services network with the selector switch in the 'Auto' position, and using the mains failure simulation push, verify that the set operates correctly with the appropriate time delay for taking up load and that the carrying of the load and its distribution over the three phases are satisfactory.
- 15) Run the set at various loads for periods totalling at least 30 minutes. Check the voltage and current in each phase in turn and that the voltage and frequency are being maintained within the required limits with large alterations of loads.

Note the rate of charge on the dynamo ammeter with the engine running (if a dynamo is fitted) and the rate of charge on the battery charging ammeter with the engine stopped. Check against manufacturer's recommendation and adjust charging rates if necessary.

- 16) Check the operation of the turbo-charger unit(if fitted) and the colour of the exhaust gas at various loads.
- 17) Check that the various engine safeguards operate satisfactorily.
- 18) Check the vibration absorbing devices for proper operation and that the performance of all flexible connections both mechanical and electrical, are satisfactory.
- 19) When all tests are satisfactory and agreed with the Architect or his representative, the lubricating oil and water levels shall be finally checked, the fuel oil tank replenished and the set left in normal operating order.
- 20) An initial supply of all lubricating oils and greases shall be provided by the Sub- Contractor.
- 21) Additional lubricating oil shall be provided for recharging the engine sump once together with a supply of lubricating oils and greases to cover the normal use and servicing of the set during the 12 months maintenance period referred to in section 47.

45. SPARE PARTS

The Sub-Contractor shall submit with his tender a separate priced list of spare parts, including any optional extras which he recommends should be purchased for the set and its control equipment and which are not supplied as standard with the unit.

46. TOOLS

A complete set of tools and general and special testing equipment shall be provided, including grease and oil guns, necessary for the normal maintenance of the set and its controls. The tools shall of the best quality, the spanners being of chrome vanadium steel and shall be contained in a suitable robust steel tool box with lid fitted with a lock and two keys. All tools and testing equipment may be used by the Sub-Contractor in the execution of the Contract works but will not be accepted as part of the Contract works unless they are handed over in clean and undamaged condition, in perfect working order and effectively in new condition.

47. MAINTENANCE

47.1 The Sub-Contractor shall maintain the complete set and associated control equipment forming the unit for a period of twelve of calendar months from the date that the unit is put into commission and regular use.

47.2 During the maintenance period, the Sub-Contractor shall at his own expenses:-

- 1) Make good any defects in the unit and replace any parts that fail or show signs of weakness or undue wear in consequence of faulty design, workmanship or materials on notification of the defect.
- 2) Visit the site and with all diligence attend to any such defect that arises within 48 hours of receiving notification of the defect.
- 3) Carry out regular examination and servicing of the unit at the intervals laid down by the manufacturer or every three months, whichever is the sooner; the service examination to include all necessary adjustments, greasing, oiling, cleaning changing of lubricating oils to keep the unit in sound and efficient working order.
- 4) Instruct the maintenance personnel in the proper operation, care and maintenance of the set and its equipment.

47.3 If during the maintenance period the unit is or is likely to be out of use for a period greater than 48 hours, due to the unit or part thereof developing a defect attributable to faulty design, workmanship or materials, or due to neglect of maintenance by the Sub-Contractor, the Sub-Contractor shall at his own expense immediately provide and install on free loan a suitable temporary unit for use until the required repair or replacement has been satisfactorily undertaken and the original set (or its replacement) put into proper working order.

47.4 At the end of the twelve months period of maintenance the Sub-Contractor shall (in addition of the normal servicing work) carry out a comprehensive examination and test of the set and its auxiliaries, including the checking of the operation of controls and safeguards, to ensure that the unit is in proper working order and in satisfactory condition for handing over to the client whose representative shall be present at such examination and test.

Signed (as in form of Tender) _____

Name of Sub-Contractor _____

Official Stamp _____

Date _____

PART I:

APPENDICES TO

TECHNICAL SPECIFICATIONS

SUPPLY INSTALLATION OF A 2X200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDICES TO TECHNICAL SPECIFICATIONS

| ITEM | CONTENTS | PAGE |
|------------------|---|-------------|
| 1. Appendix 1: | Information to the Tenderer | |
| 2. Appendix 2: | Information to be supplied by the Tenderer | |
| 3. Appendix 3: | Data from the Tenderer | |
| 4. Appendix 4: | List of tools to be supplied with Each Set | |
| 5. Appendix 5: | List of Spare Parts and Lubricants to be supplied with Each Set | |
| 6. Appendix 6: | Earthing | |
| 7. Appendix 7: | Drawings, Literature, Manuals and Delivery Period | |
| 8. Appendix 8: | Warranty of Set | |
| 9. Appendix 9: | Foreign Currency | |
| 10. Appendix 10: | Annual Maintenance | |
| 11. Appendix 11: | External Fuel Tank | |
| 12. Appendix 12: | Hot Air Ducting | |

SUPPLY AND INSTALLATION OF A 2X200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 1

INFORMATION TO THE TENDERER

| Section | Item | Requirements |
|---------|---|---|
| 1. | Operating Conditions:- | |
| 1.1 | Site (address and details) | Jaramogi Oginga Odinga University of Science and Technology, Bondo |
| 1.2 | Altitude | 1266 m asl |
| 1.3 | Temperature range humidity | As stated in Part 3, Technical Specifications to operate in Unheated building |
| 2 | Functional requirements | Automatic Mains Failure |
| 3. | Performance | 2x200KVA,415/240V, 3-Phase ON SITE. The Engine to be configured for Standby |
| 4 | Set arrangement | |
| 4.1 | Weather proof roof and removable side panels | Required |
| 5 | Remote governor control | Electronic governor required |
| 6 | Aspiration | Natural |
| 7 | Manual starting for sets larger than 35 kW | Required |
| 8 | Silencer Details of additional pipework and fittings if required | Required |
| 9 | Daily service tank | Required |

APPENDIX No. 1 (Contd)

| Section | Item | Requirements |
|----------------|---|---------------------|
| 9.1 | Manual transfer pump | Required |
| 9.2 | Fuel storage tank (external) | Required |
| 9.3 | Fuel jettison cock, fuel tank | Required |
| 10 | Engine Instruments Details if not as stated | Required. |
| 11. | Cooling system | Water/Air |
| 11.1 | Water cooling Radiator mounting | On engine |
| 11.2 | Provision for hot air ducting | Required |
| 12. | Electrical control panel | |
| | ○ main switch | Circuit breaker |
| | ○ provision for parallel running | Not required |
| | ○ alternator field circuit | Switch |
| | ○ "exciter" | Not required |
| 12.1 | Kilowatt meter | Required |
| 12.2 | Lock-out remote indication circuit | Required |
| 12.3 | Service terminals | Required |
| 13 | Earth field | Required |
| 14 | Building drawings, as comments to issued drawings. | Required |

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 2

INFORMATION TO BE SUPPLIED BY THE TENDERER

| Item | Details |
|---|----------------|
| 1. Diesel Engine | |
| Make and type | |
| Bore | |
| Stroke | |
| Net continuous rating in HP (B.S. 5574) | |
| a) at sea level | |
| b) on site | |
| Speed | |
| Year this type put into service | |
| Total number sold | |
| a) World wide | |
| b) in East Africa | |
| c) in Kenya | |
| Supercharger: make and type number in use | |
| Thermometers: make and type | |
| Air cooling:- | |
| Quantity of air required | |
| details of ducting required | |
| Water cooling:- | |
| details of water cooling circuits | |

APPENDIX No. 2 (Contd)

| Item | Details |
|--------------------------------|---------|
| Radiator: make and type | |
| length | |
| breadth | |
| height | |
| Heat exchanger: make and type | |
| Aspiration | |
| Quantity of air required | |
| 2. Auxiliaries | |
| Lubricating oil circuits | |
| Filters | |
| Coolers | |
| Primary pumps | |
| Tachometer and drive | |
| Governor | |
| Special cold start devices | |
| Running hours meter | |
| Safety devices:- | |
| High temperature | |
| Low pressure (lubricating oil) | |
| Cooling water flow trip | |
| Over speed trip | |
| Speed sensing devices | |
| Lubricating oil thermometers:- | |
| Number | |
| position(s) | |
| Water thermometer:- | |
| position | |
| Starting battery and charger | |
| 3. Lubrication | |
| Recommended oil(s) | |

APPENDIX No. 2 (Contd)

| | Item | Details |
|----|--------------------------------------|---------|
| 4. | Alternator and Exciter | |
| | Make and type | |
| | Bearings | |
| | Insulation (B.S. 2757) | |
| | Quantity of cooling air required | |
| 5. | Electrical Control Panel | |
| | Automatic voltage regulator: | |
| | make and type | |
| | where mounted (if not on panel) | |
| | Control circuits and wiring diagrams | |
| | Relays:- | |
| | make and type | |
| | method of delayed operation | |
| | Meters: make and type | |
| | Circuit Breaker: make and type | |
| 6. | Automatic Changeover | |
| | Motorised Breakers | |
| | Dimensions | |
| | Type and control switches | |
| | Current drawn from | |
| | control supply under | |
| | standby conditions | |
| | Type of mounting | |
| | Contactor: make and type | |
| | Relays : make and type | |
| | Fuses : make and type | |

APPENDIX No. 2 (Contd)

| Item | | Details |
|-------------|-------------------------|-------------------------------|
| 7. | Performance Data | |
| | Fuel consumption | |
| | Rated Output % | Fuel Consumption L /hr |
| | 110 | |
| | 100 | |
| | 75 | |
| | 50 | |
| 8. | Exhaust Fans | |
| | Type | |
| | Rating | |
| 9. | Generator Set | |
| | Full Length | mm |
| | Width | mm |
| | Hieght | mm |
| | Weight | Kg |

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 3

DATA FROM THE TENDERER

1. Initial sound level measured in accordance with the N.E.M.A. standards (Must be less than 60 dBA at 1m) dBA
2. Means of vibrations dampers mounted on the generator set to prevent vibrations to be transferred from the generator set to the building

SUPPLY INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 4

LIST OF TOOLS TO BE SUPPLIED WITH EACH SET

The following tools shall be handed over to the Client or Engineer before completion of the contract:-

| Item | Description | Price | KShs. |
|--|--|-------|-------|
| 1. | Metal tool box with lock and keys | | |
| 2. | Set of 8 No. Chrome vanadium ring spanners in sizes to suit the set | | |
| 3. | Set of 8 No. Chrome vanadium open-ended spanners in sizes to suit the set | | |
| 4. | Set of screwdrivers, 75 mm, 200 mm and 300 mm plus one 200 mm Philips type | | |
| 5. | One set of feeler gauges | | |
| 6. | One grease gun to suit greasing points | | |
| 7. | One oil can, trigger type | | |
| 8. | One Hydrometer and Plastic Filler bottle with pouring spout | | |
| Total carried forward to Price Summary Schedule. | | | |

The tenderer shall give below details of any special tools which he recommends should be purchased as an optional extra.

| Item | Description | Price | KShs. |
|------|-------------|-------|-------|
| | | | |

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 5

LIST OF SPARE PARTS AND LUBRICANTS TO BE SUPPLIED WITH EACH SET

The following items shall be handed over to the Client or Engineer before completion of the contract.

These items shall not be used by the Sub-Contractor to carry out his normal maintenance.

| Item | Description | Price | KShs. |
|------|--|-------|-------|
| 1. | Oil Filters - 3 Nos. | | |
| 2. | Air Filters - 3 Nos. | | |
| 3. | One injector to suit the set | | |
| 4. | One set of fan belts comprising belts | | |
| 5. | One set of indicator bulbs comprisingbulbs | | |
| 6. | One set of indicator lenses comprisinglenses | | |
| 7. | One overhaul kit | | |
| 8. | One set of fuses comprising..... fuses | | |
| 9. | One 200 litre drum of sump grade oil | | |
| 10. | One 2 kilogram tin of grease of grade | | |
| 11. | One 10 litre plastic container of distilled water | | |
| | | | |

The tenderer shall give below details of any other spares which he recommends should be purchased as optional extra.

| Item | Description | Price | KShs. |
|------|-------------|-------|-------|
| | | | |

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 6

EARTHING

| Item | Description | Price | KShs. |
|--|--|-------|-------|
| 1. | Supply and install, for each set, 4 No. steel cored copper earth rods, 1200 mm x 12 mm threaded for extension, connected by brass clamps to 30 metres of 25 mm x 3 mm copper earth tape laid in trenches of minimum depth 300 mm and fixed to the wall of the generator room with brass spacer bar saddles at 1 metre of intervals, connected to the station earth bar via a brass test clamp. | | |
| Total carried forward to Price Summary | | | |

Note: The earthing must be carried out strictly as above.

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 7

DRAWING, LITERATURE, MANUALS AND DELIVERY PERIOD

1. Details of Drawings, Literature, manuals etc. included with tender documents.
2. Time in **weeks** from acceptance of tender to delivery of equipment on site. _____ Weeks
3. Time in **weeks** from acceptance of tender to commissioning of set(s). _____ Weeks

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 8

WARRANTY OF SET

The warranty period for the set and all its auxiliaries, from the date of commissioning,

will be _____ months

(Note: A minimum of 12 months is required).

Signed: (as in Tender) _____

Date: _____

**SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY
GENERATOR SET**

APPENDIX NO. 9

FOREIGN CURRENCY

State Foreign currency used in the pricing and rate of exchange to the Kenya Shilling.

1 _____ (Foreign Currency) = _____ Shillings.

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 10

ANNUAL MAINTENANCE

Cost of Annual Maintenance shall be Ksh. _____ per year.

Signed: (as in Tender) _____

Date: _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 11

EXTERNAL FUEL TANK

- 5,000 litres (5 m³) external diesel fuel tank made from 10 gauge galvanized pressed steel, external (welded) 50mm square steel-bar diagonal and vertical supports.
2m high x 2.5 m long x 1m wide steel stand in 8 gauge 100mm x 100mm (welded) hollow steel tubes and the following:-
 - Internal stays
 - 18 gauge galvanized steel cover lid
 - Manual hand-operated fuel transfer pump with hose connection
 - Connection for 15mm diameter class B gms pipe with “CRANE” gate valve and union.
 - 6m long 15mm diameter class B gms pipe
 - 4 No. Galvanized malleable iron elbow
 - 20mm diameter drain pipe with “CRANE gate valve
 - Clear accurately-calibrated level indicating tubing connection on the outside.
 - All other accessories

KSh. _____

SUPPLY AND INSTALLATION OF A 2x200 KVA SOUND-ATTENUATED STANDBY GENERATOR SET

APPENDIX NO. 12

HOT AIR DUCTING

Hot air-duct comprising:

| | | | |
|----|--|---|--------------------|
| 1. | Galvanized mild steel sheet 3mm thickness | - | 120 m ² |
| 2. | Square hollow section tubes 50mm x 50mm, 3mm thickness | - | 120 m |
| 3. | Heat resistant fibre glass | - | 60 m ² |
| 4. | Allow for welding the metal and applying prime coat of paint | - | Item |
| 5. | 50mm x 50mm x 3mm weldmesh infront of ventilation duct | - | 10 m ² |

PART J:

**FULL SERVICE MAINTENANCE PER
YEAR AFTER EXPIRY OF DEFECTS
LIABILITY PERIOD**

PART J: FULL SERVICE MAINTANANCE PER YEAR AFTER EXPIRY OF DEFECTS LIABILITY PERIOD

SPECIAL NOTES

1. The tenderer is advised to note that their price shall be used in the evaluation of the tenders.
2. The tenderer shall price for both labour and consumables (materials) during the 12 months full service period in appenix A of this section. The price shall be for supply, installation, testing and commissioning including all taxes applicable at the time of tender.
3. The tenderer shall list and price the consumable/ spare parts/ materials to be used during the 12 months full service period in appenix B of this section. The price shall be for supply, installation, testing and commissioning including all taxes applicable at the time of tender.
4. The tenderer shall list and price the consumable/ spare parts/ materials to be used during the 36 months full service period. This list is to be comprehensive as possible and shall inculde major spares as cards, fan motors etc. The price shall be for supply, installation, testing and commissioning including all taxes applicable at the time of tender. These are the spare parts that are not required during the normal routine maintenance. These spare parts shall only be paid for as and when repalced. The tenderer shall give the details of these spare parts in in appenix C of this section.
5. The price quoted for the above shall be as per the Standard Maintanance Tender Document.
6. The tenderer shall be required to the sign the 12 Months after Defects Liability Maintanance Contract based on the price quoted and the Standard Maintanance Tender Document refered to in item 5 above.
7. The tenderer **MUST** fill all the prices and rates in the Appendices A, B and C of this section. Failure to do so shall lead to disqualification.

APPENDIX 'A'

PRICE FOR FULL NORMAL ROUTINE MAINTANANCE PER YEAR AFTER DEFECTS LIABILITY PERIOD

| Item | Description | Kshs | Cts |
|---|--|-------------|------------|
| 1.0 | Labour costs per month | | |
| 2.0 | Material costs for spare parts (consumables) per month – see Appendix C of this section | | |
| Sub-total for one (1No.) Month Maintenance after the Defects Liability Period (Not to be carried to Form of Tender) | | | |
| Grand Total for 12 Months Maintenance after the Defects Liability Period (Not to be carried to Form of Tender) | | | |

Signed by the Tenderer.....

Official Stamp

Date.....

APPENDIX 'B'

SCHEDULE OF UNIT RATES OF SPARES THAT MAY BE REQUIRED DURING 12 MONTHS AFTER DEFECTS LIABILITY MAINTENANCE PERIOD (ATTACHMENTS ARE ALLOWED IF THE LIST IS LONG)

| Item | Description | Unit | Qty | Cost(Kshs.) |
|--|-------------|------|-----|-------------|
| | | | | |
| Total (Not to be carried to Form of Tender) | | | | |

Signed By Tenderer

Official Stamp

.....

Date

APPENDIX 'C'

PRICE BREAKDOWN OF SPARES / CONSUMABLES TO BE USED DURING 12 MONTHS AFTER DEFECTS LIABILITY MAINTENANCE PERIOD

NOTE: The Price Total in this Appendix C SHOULD tally with the Grand Price Total in Appendix A of this section.

| Item | Description | Unit | Qty | Cost(Kshs.) |
|--|-------------|------|-----|-------------|
| | | | | |
| Total (Not to be carried to Form of Tender) | | | | |

Signed By Tenderer

Official Stamp

.....

Date


SECTION VI:

DRAWINGS

- Note
1. A list of drawings
 2. The actual Contract drawings including site plans should be annexed in a separate booklet.


JOB No. 1801

PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

| DRAWING No. | DRAWING TITLE | DATE | REVISIONS | | | | | | | |
|---|---|---------------------|-----------------|-----------------|---------------------|--------|---|---|---|---|
| | | | A | B | C | D | E | F | G | H |
| | <u>ADMINISTRATION BLOCK</u> | 8.03.18 | ✓ | | | | | | | |
| | <u>SUB BASEMENT FLOOR PLAN</u> | 2.05.18 | | ✓ | | | | | | |
| | | 10.07.18 | | | ✓ | | | | | |
| E1801-01 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-02 | POWER LAYOUT | | | | | | | | | |
| E1801-03 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-04 | SECURITY LAYOUT | | | | | | | | | |
| | <u>GROUND FLOOR PLAN</u> | | | | | | | | | |
| E1801-05 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-06 | POWER LAYOUT | | | | | | | | | |
| E1801-07 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-08 | SECURITY LAYOUT | | | | | | | | | |
| | <u>GATEHOUSE</u> | | | | | | | | | |
| E1801-08A | LIGHTING,POWER,FIRE ALARM AND SECURITY LAYOUT | | | | | | | | | |
| | <u>FIRST FLOOR PLAN</u> | | | | | | | | | |
| E1801-09 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-10 | POWER LAYOUT | | | | | | | | | |
| E1801-11 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-12 | SECURITY LAYOUT | | | | | | | | | |
| | <u>SECOND FLOOR PLAN</u> | | | | | | | | | |
| E1801-13 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-14 | POWER LAYOUT | | | | | | | | | |
| E1801-15 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-16 | SECURITY LAYOUT | | | | | | | | | |
| REVISIONS | | | | | | | | | | |
| DATE | | | | | | | | | | |
| ARCHITECT : | | | | | | | | | | |
| <p style="text-align: center;">BASELINE ARCHITECTS P.O. Box39928-00623 Nairobi, Kenya.</p> | | | | | | | | | | |
| <p>SERVICES ENGINEERS:</p> <div style="border: 1px solid black; padding: 5px;">  <p>FERADON ASSOCIATES LTD CONSULTING ENGINEERS P.O BOX 7375-00300 TEL. 0202392117 OR 0202392149. NAIROBI. E-MAIL : consult@feradon.com</p> </div> | | | | | | | | | | |
| <p>JOB No. 1801 PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY</p> | | | | | | | | | | |
| DRAWING TITLE: DRAWING LIST – ELECTRICAL INSTALLATIONS. | | | | | | | | | | |
| DES/DRN. C.O/W.O | APPROVED. Eng.N.G | DATE. JULY, 2018 | SCALE. N.T.S | JOB No. 1801 | DRG No. E1801-00 | REV. C | | | | |


JOB No. 1801

PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

| DRAWING No. | DRAWING TITLE | DATE | REVISIONS | | | | | | | |
|--|-----------------------------|---------------------|-----------------|-----------------|---------------------|--------|---|---|---|---|
| | | | A | B | C | D | E | F | G | H |
| | <u>THIRD FLOOR PLAN</u> | 8.03.18 | ✓ | | | | | | | |
| | | 2.05.18 | | ✓ | | | | | | |
| | | 10.07.18 | | | ✓ | | | | | |
| E1801-17 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-18 | POWER LAYOUT | | | | | | | | | |
| E1801-19 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-20 | SECURITY LAYOUT | | | | | | | | | |
| | <u>FOURTH FLOOR PLAN</u> | | | | | | | | | |
| E1801-21 | LIGHTING LAYOUT | | | | | | | | | |
| E1801-22 | POWER LAYOUT | | | | | | | | | |
| E1801-23 | FIRE ALARM LAYOUT | | | | | | | | | |
| E1801-24 | SECURITY LAYOUT | | | | | | | | | |
| | <u>ROOF PLAN</u> | | | | | | | | | |
| E1801-25 | LIGHTNING PROTECTION LAYOUT | | | | | | | | | |
| E1801-26 | SITE PLAN | | | | | | | | | |
| E1801-27 | SCHEDULE OF SYMBOLS | | | | | | | | | |
| | <u>RAW POWER</u> | | | | | | | | | |
| E1801-28 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-29 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-30 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-31 | SCHEMATIC LAYOUT | | | | | | | | | |
| REVISIONS | | | | | | | | | | |
| DATE | | | | | | | | | | |
| ARCHITECT : BASELINE ARCHITECTS P.O. Box39928-00623 Nairobi, Kenya. | | | | | | | | | | |
| SERVICES ENGINEERS: <div style="display: flex; align-items: center;">  <div> FERADON ASSOCIATES LTD CONSULTING ENGINEERS P.O BOX 7375-00300 TEL. 0202392117 OR 0202392149. NAIROBI. E-MAIL : consult@feradon.com </div> </div> | | | | | | | | | | |
| JOB No. 1801 PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY | | | | | | | | | | |
| DRAWING TITLE: DRAWING LIST – ELECTRICAL INSTALLATIONS. | | | | | | | | | | |
| DES/DRN. C.O/W.O | APPROVED. Eng.N.G | DATE. JULY, 2018 | SCALE. N.T.S | JOB No. 1801 | DRG No. E1801-00 | REV. C | | | | |

JOB No. 1801

PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

| DRAWING No. | DRAWING TITLE | DATE | REVISIONS | | | | | | | |
|---|-----------------------|---------------------|-----------------|-----------------|---------------------|--------|---|---|---|---|
| | | | A | B | C | D | E | F | G | H |
| E1801-32 | SCHEMATIC LAYOUT | 8.03.18 | ✓ | | | | | | | |
| | | 2.05.18 | | ✓ | | | | | | |
| E1801-33 | SCHEMATIC LAYOUT | 10.07.18 | | | ✓ | | | | | |
| | <u>CLEAN POWER</u> | | | | | | | | | |
| E1801-34 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-35 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-36 | SCHEMATIC LAYOUT | | | | | | | | | |
| E1801-37 | UPS BOARD | | | | | | | | | |
| E1801-38 | MAIN SCHEMATIC LAYOUT | | | | | | | | | |
| REVISIONS | | | | | | | | | | |
| DATE | | | | | | | | | | |
| ARCHITECT : BASELINE ARCHITECTS P.O. Box39928-00623 Nairobi, Kenya. | | | | | | | | | | |
| SERVICES ENGINEERS: <div style="display: flex; align-items: center;">  <div> FERADON ASSOCIATES LTD CONSULTING ENGINEERS P.O BOX 7375-00300 TEL. 0202392117 OR 0202392149. NAIROBI. E-MAIL : consult@feradon.com </div> </div> | | | | | | | | | | |
| JOB No. 1801 PROJECT: PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY | | | | | | | | | | |
| DRAWING TITLE: DRAWING LIST – ELECTRICAL INSTALLATIONS. | | | | | | | | | | |
| DES/DRN. C.O/W.O | APPROVED. Eng.N.G | DATE. JULY, 2018 | SCALE. N.T.S | JOB No. 1801 | DRG No. E1801-00 | REV. C | | | | |

SECTION VII:

BILLS OF QUANTITIES

Notes for preparing Bills of Quantities

1.0 Preamble To Bill of Quantities

- a) The Bill of Quantities shall form part of the Contract Documents and is to be read in conjunction with the Instructions to Tenderers, Conditions of Contract Parts I and II, Specifications and Drawings.
- b) The brief description of the items in the Bill of Quantities is purely for the purpose of identification, and in no way modifies or supersedes the detailed descriptions given in the conditions of Contract and Specifications for the full direction and description of work and materials.
- c) The Quantities set forth in the Bill of Quantities are estimated and provisional, representing substantially the work to be carried out, and are given to provide a common basis for tendering and comparing of Tenders. There is no guarantee to the Contractor that he will be required to carry out all the quantities of work indicated under any one particular item or group of items in the Bill of Quantities. The basis of payment shall be the Contractor's rates and the quantities of work actually done in fulfilment of his obligation under the Contract.
- d) The prices and rates inserted in the Bills of Quantities will be used for valuing work executed, and the Engineer will measure the whole of the works executed in accordance with this Contract.
- e) A price or rate shall be entered in ink against every item in the Bill of Quantities with the exception of items, which already have provisional sums, affixed thereto. The Tenderers are reminded that no "nil" or "included" rates or "lump-sum" discounts will be accepted. The rates for various items should include discounts if any. Tenderers who fail to comply will be disqualified.
- f) Provisional sums (including Dayworks) in the Bill of Quantities shall be expended in whole or in part at the discretion of the Engineer in accordance with Sub-clause 52.4 and Clause 58 of part of the Conditions of Contract.
- g) The price and rates entered in the Bill of Quantities shall, except insofar as it is otherwise provided under the Contract, include all Constructional plant to be used, labour, insurance, supervision, compliance, testing, materials, erection, maintenance or works, overheads and profits, taxes and duties together with all general risks, liabilities and obligations set out or implied in the Contract, transport, electricity and telephones, water, use and replenishment of all consumables, including those required under the Contract by the Engineer and his staff.

- h) Errors will not be corrected by the Employer for any arithmetic errors in computation or summation
- i) The Bills of Quantities, unless otherwise expressly stated therein, shall be deemed to have been prepared in accordance with the principles of the latest edition of the Civil Engineering Standard Method of Measurement (CESMM).
- j) “Authorised” “Directed” or “Approved” shall mean the authority, direction or approval of the Engineer.
- k) Unless otherwise stated, all measurements shall be net taken on the finished work carried out in accordance with the details shown on the drawings or instructed, with no allowance for extra cuts or fills, waste or additional thickness necessary to obtain the minimum finished thickness or dimensions required in this Contract. Any work performed in excess of the requirements of the plans and specifications will not be paid for, unless ordered in writing by the Engineer.
- l)
 - (a) Hard material, in this Contract, shall be defined as the material which, in the opinion of the Engineer, require blasting, or the use of metal wedges and sledgehammers, or the use of compressed air drilling for their removal, and which cannot be extracted by ripping with a dozer tractor of at least 150 brake horse power (112 kilowatt) with a single, rear-mounted, hydraulic ripper. Boulders of more than 0.2m³ occurring in soft material shall be classified as hard material
 - (b) Soft material shall be all material other than hard material.

2.0 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 Bills of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bills 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 Bills of Quantities should be as simple and brief as possible.

3.0 The Bills of Quantities should be divided generally into the following sections:

- (a) **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 Bills 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.

(b) 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 Bills of Quantities.
- (ii) The brief description of the items in the Bill of Quantities should in no way modify or supersede the detailed descriptions given in the Contract drawings, Conditions of Contract and Specifications.
- (iii) 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.
- (iv) The following units of measurement and abbreviations are recommended for use.

| <i>Unit</i> | <i>Abbreviation</i> | <i>Unit</i> | <i>Abbreviation</i> |
|-----------------------|------------------------|-------------------|--------------------------|
| 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 | | |

- (v) 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.

(c) Daywork Schedule

A Daywork Schedule should be included if the probability of unforeseen work, outside the items included in the Bills 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:

- (i) a list of the various classes of labour, and materials for which basic Daywork 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 Daywork basis; and
- (ii) a percentage to be entered by the tenderer against each basic Daywork Subtotal amount for labour, materials and plant representing the Contractor's profit, overheads, supervision and other charges.

(d) Provisional Quantities and Provisional 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 Bills 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 Bills of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a "Provisional Sum" in the Summary of the Bills 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 specialised Works should be included as a section of the main Bill 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.

- (iii) Unless otherwise provided in the Contract, the Provisional Sums included in the Bills of Quantities should always be expended in whole or in part at the discretion of the Engineer after full consultation with the Employer.

(e) Summary

The Summary should contain a tabulation of the separate parts of the Bills of Quantities carried forward, with Provisional Sums for Dayworks, physical (quantity) contingencies, and price contingencies (upward price adjustment) where applicable.

SECTION VII: BILLS OF QUANTITIES

CONTENTS:

| CLAUSE NO. | DESCRIPTION |
|-------------------|-----------------------------------|
| 1. | General Notes to Tenderers |
| 2. | Statement of Compliance |
| 3. | Bills of Quantities |

BILLS OF QUANTITIES

1. General Note to Tenderers

- 1.1 The total of the prices in the summary of prices shall include for the whole of the Contract works in accordance with the specifications as defined before and shall be carried forward to Form of Tender.
- 1.2 Any prices omitted from any item, section or part of the price schedule shall be deemed to have included in another item, section or part.
- 1.3 The prices shall include for all obligations under the Contract including and not limited to:
 - a) Supply of any materials, equipment, apparatus, fittings, spares and tools
 - b) Insurance
 - c) Clearing and forwarding
 - d) Delivery, handling and storage at site
 - e) Packing for storage
 - f) Replacing any defective or damaged item
 - g) Installation
 - h) Testing
 - i) Painting
 - j) Commissioning
 - k) Maintenance during the defects liability period
- 1.4 The unit rates shall include import duty and VAT where applicable, and shall be expressed in Kenya Shillings.
- 1.5 The Sub-contractor is instructed to read all the pages, and all the items of the Bills of Quantities very carefully. Should there be an apparent omission of words or figures, or should the sub-contractor be in doubt about the precise meaning of any word or figures, or for any reason whatsoever feel more clarification is necessary, either in the drawings or Bills of Quantities, to facilitate reasonable pricing of the tender document, he should inform the engineer at once so that the correct interpretation or clarification may be given before tendering. No liability will be accepted on mistakes and/or omissions which should have been corrected in the format above.

1.6 The specification should be priced in Kenya Currency i.e Shillings and cents.

1.7 The following meanings/interpretations shall be attached:-

- . **Lighting Point:** "Install a lighting point complete with concealed diameter 20mm H.G PVC conduit, conduit couplers, box, wiring in 3x4.0 mm² SC-PVC-CU cables and all accessories, but excluding the light switch".
- . **Socket Outlet:** "Install 13A power outlet comprising concealed diameter 20mm H.G PVC conduit, conduit couplers, box, ring main wiring in 6x2.5mm² SC-PVC-CU cables and all accessories including 13A switched socket". All socket outlets must have safety shutters on both live and neutral.
- . **Telephone Point:** "Install telephone cord outlet point complete with telephone jack-plug, concealed diameter 25mm H.G PVC conduit box, and draw wire." All Telephone outlets must have continuous diameter 25mm links throughout respective buildings.
- . **20A DP Outlet:** "Install outlet for 20A DP switch comprising concealed diameter 25mm H.G PVC conduit, wiring in 3x4.0mm² SC-PVC-CU cables, box, 20A DP switch with neon light and all accessories".
- . **Electric Door Lock:** "Install an outlet for electric door lock comprising concealed diameter 20mm H.G PVC conduit box, wiring in 3x2.5mm² SC-PVC-CU cables, and all accessories including flush mounted electric door lock as YALE, or approved equivalent, (supplied with a key for use when power fails) complete with an integral transformer, and wired to, and complete with, a spring-loaded 5A switch marked "press". The two electric door locks in the "Air-lock" shall be wired so that both CAN NOT be opened at the same time.
- . **Fire Alarm Point:** "Install outlet for fire alarm sensor/sounder comprising concealed 20mm H.G PVC conduit, box, wiring in 3x2.5mm² "Firetuff" cables and all accessories". All fire alarm points must be inter-linked with diameter 20mm conduits.
- . **Consumer Unit:** "Supply and install SP/N power consumers unit, complete with SP/N integral isolator".
- . **Distribution Board:** "Supply and install TP/N power distribution board, complete with TP/N integral isolator."
- . **Main Switchboard:** Supply and install main switchboard free standing complete with all switchgear, as per schematics shown.
- . **Meterboards:** Supply and install metal clad meterboards C/W

all

switchgear.

- . **Earthing:** "Protective multiple earthing to Kenya Power and Lighting Co. standards, comprising 1200mm deep-

driven pure electrolytic copper earth electrode, electrode clamps, 16mm² yellow/green earth lead, earth pit complete with cover and all accessories".

. Labelling: "Comprehensive, concise and instructive permanent labelling of all the sub-circuits, complete with identification of the sizes of all the sub-circuit cables, permanent traffolyte identification of the board such as "DB. A" and identification of the sizes of the sub-mains and their origin e.g "Board A: Supply: 4x16mm² SOURCE: DB.1"

. Blanking Plates: "Supply and install blanking plates in all the spare ways."

. Switched Spur Outlet: Install 13A fused switched spur outlet with neon light and 5A integral fuse, complete with concealed diameter 20mm H.G PVC conduit, box, wiring in 6x2.5mm² ring main wiring for computer power supply and all accessories."

. Cooker outlet: Install 45A DP cooker control unit, complete with twin metal box, concealed 25mm H.G PVC conduit, box, wiring in 3x6.0mm² SC-PVC-CU cables and all accessories including 45A DP cooker control unit, with an integral socket, neon lights, and cooker connector unit.

- 1.8 Unless specifically stated otherwise, all light fittings will be as Thorn manufacture. All power accessories, sockets, telephone outlets, TV outlets, distribution boards/consumer units, switches, spur outlets etc must either be Crabtree, MK or Merlin Gerin. Approved equivalent makes may be accepted subject to the engineer's prior approval.
- 1.9 The Sub-contract is for supplying, delivering, fixing/installing, testing, commissioning and setting to work to the full satisfaction of the Engineer/Architect and the Sub-contractor's price must include all cost for the entire process.
- 1.10 All conduits/ducts must be heavy gauge. Where steel pipes are specified, they must be minimum of class B in strength.
- 1.11 The installation shall be carried out strictly in accordance with the provision of the 16th Edition of Wiring Regulation as published by the Institution of Electrical Engineers, Great Britain, the most current relevant standards issued by the Kenya Bureau of Standards, and with strict adherence to the safety requirements and by-laws of the Kenya Power and Lighting Co. Ltd.
- 1.12 The Sub-contractor shall ensure that the highest standards of workmanship and highest quality materials are used at all times. Inferior workmanship and low quality materials shall be rejected and replaced at the Sub-contractors own cost.

- 1.13 The sub-contractors shall be solely responsible for the correct and accurate ordering of materials in accordance with the drawings and Bills of Quantities.
- 1.14 No claims on advance payment and/or materials off-site will be allowed unless the sub-contractor advances valid reasons acceptable to the employer. Should a claim on advance payment be allowed, the sub-contractor will be required to submit an Advance Payment Bond for the full value claimed.
- 1.15 The sub-contractor shall strictly follow the Main Contractor's programme of works and (the sub-contractor) must ensure that at no time does his activities cause delays to the Main Contractor.
- 1.16 This is a fixed price sub-contract, and the sub-contractor is expected to allow (in his unit rates) for generous fore-casts on fluctuations.
- 1.17 The Bills of Quantities shall be read in conjunction with Notes to All Tenderers, Preliminaries, General Specifications, Particular Specifications and all the relevant drawings.
- 1.18 A rate or price shall be entered against each item in the priced Bills of Quantities whether quantities are stated or not. The cost of items against which the sub-contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bills of Quantities.
- 1.19 The whole cost of complying with provisions of the sub-contract shall be included in the items provided in the Bills of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of work.
- 1.20 General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bills of Quantities. Reference to the relevant sections of the sub-contract document shall be made before entering prices against each item in the priced Bills of Quantities.
- 1.21 Provisional sums and contingencies included and so designated in the Bills of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer.
- 1.22 Errors in pricing will be corrected by the Employer for any arithmetic errors in computation or summarization as follows:-
- a) Where there is a discrepancy between amounts in figures and amounts in words, the amount in words will govern.
 - b) Where there is discrepancy between the unit rate and the total amount derived from the multiplication of the unit price and the quantity, the unit rate quoted will govern unless in the opinion of the employer, there is an obviously gross misplacement of the decimal point in the unit prices, in which event the total amount as quoted will govern and the unit rate will be corrected.

- 123 Other than ceiling mounted fixtures, accessories, light fittings etc, all the other mounting heights will be re-confirmed with the Engineer/Architect on site.
- 124 All light fittings must be complete with appropriate lamps, bulbs, tubes, starters, control gear etc as applicable. Where a light fitting has multiple lamps, tubes, bulbs, each lamp/tube/bulb must have its own separate choke/starter/p.f. correction capacitor/control gear etc.
- 125 **All the switch-gear and power distribution accessories (Distribution Boards, circuit Breakers, isolators, etc) will either be Merlin Gerin (Multi-9), Crabtree, or square-D. Alternative makes can only be accepted with the engineer's prior approval.**

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 1 –MAINS POWER DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following:- | | | | | |
| 1.00 | An automatic voltage regulator with the following characteristics: - | | | | | |
| | i. Rating: 400 KVA | | | | | |
| | ii. Power Supply: 3 Phase, 415V/240V | | | | | |
| | iii. Input Voltage Tolerance: 20% i.e. | | | | | |
| | from 365-505V 3 Phase | | | | | |
| | from 192-288V 1 Phase | | | | | |
| | iv. Operation: Independent correction for each Phase | | | | | |
| | v. Output: $\pm 1\%$ of 415V/240V | | | | | |
| | vi. Frequency 50/60Hz $\pm 5\%$ | | | | | |
| | vii. Rated Current: 570 Amps | | | | | |
| | viii. Admitted Load Variation 0 to 100% | | | | | |
| | ix. Admitted Load unbalance up to 100% | | | | | |
| | x. Correction Speed: 16ms/V | | | | | |
| | xi. Waveform distortion $<0.2\%$ | | | | | |
| | xii. Efficiency 98% | | | | | |
| | xiii. Cooling: Natural air cooled (free convection without fans) | | | | | |
| | xiv. Ambient temperature: -10°C to $+40^{\circ}\text{C}$ | | | | | |
| | xv. Storage temperature: -20°C to $+60^{\circ}\text{C}$ | | | | | |
| | xvi. Relative Humidity: 90% (without condensate) | | | | | |
| | xvii. Warranty: Not less than 2 Years | | | | | |
| | xviii. State Dimensions of the AVR (WxDxH) | | | | | |
| | xvix. State Weight of the AVR. | | | | | |
| | xx. State Protection degree of the AVR. | | | | | |
| | xxi. State Make, country of origin and model of the AVR. | | | | | |
| | (The AVR to be complete with 7-position selector to read input/output (PH/PH), internal trimmer to adjust output voltage \pm, Pilot lamps for operating status, Input/Output terminals boards) | 1 | No | | | |
| 1.10 | 630A TPN Motorized MCCB with adjustable time-delay, enclosed in the Main switchboard Assembly and to be adjustable from 378A-630A | 1 | No | | | |
| 1.11 | 630A TPN Manual by-pass system across the AVR to be complete with 3 No 630A TPN Manual change over switches and incorporated in the main switchboard assembly | 1 | No | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 1.20a) | 150KVars automatic power factor correction capacitor bank switched in 2 steps of 50KVars, 3 steps of 10 KVars and 4 steps of 5KVars. The bank to be made from low-loss bio-degradable capacitive units, complete with earthed enclosure. All the contactors controls and indicator lamps, including a digital read-out screen to be included. | 1 | No. | | | |
| b) | 250A TPN Motorized MCCB with adjustable time-delay, for Capacitor bank and to be adjustable from 150A-250A | 1 | No | | | |
| c) | 4core 95mm sq. PVC/SWA/PVC copper cable | 15 | m. | | | |
| d) | Cable glands for above cable | 2 | No | | | |
| d) | Cable lugs for the above cable complete with hydraulic crimping | 8 | No | | | |
| 1.30 | Free-standing purpose made front access main LV switchboard inside the Power House manufactured in 14SWG galvanised mild steel sheet and finished in cream (or appropriate colour) powder coating as shown on the schematic (the other details as per Particular Specification), complete with the following : | | | | | |
| (a) | Digital multimeter capable of measuring voltage in the range 0 – 1000V, 3-phase, current in the range 0-800A, 3-phase, and all power system parameters (KW, KVA, KWHr, KVars, Frequency, P.F., harmonics and all the parameters). The multimeter to have an accessible terminal for connecting an external printer, and should be complete with selector switches for viewing/displaying the various parameters. | | | | | |
| (b) | Set of neon phase presence indicator lamps | | | | | |
| (c) | 3 No. 630A TPN MCCB (adjustable in 378-630A range) main incomer. The MCCB to be motorized and have both electrical and mechanical inter-lock. | | | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| (d) | 5 No. 800A TPN insulated copper bus bars of 100 x 20mm cross section. | | | | | |
| (e) | 1 No. 450A TPN motorized MCCBs as shown, but adjustable in the range 270 –450A | | | | | |
| (f) | 1 No. 150A TPN motorized MCCBs as shown, but adjustable in the range 90 –150A | | | | | |
| (g) | 3 No. 100A TPN motorized MCCBs as shown, but adjustable in the range 60 –100A | | | | | |
| (h) | 2 No. 63A TPN motorized MCCBs as shown, but adjustable in the range 37.8 –63A | | | | | |
| (i) | 2 No. 32A TPN motorized MCCBs as shown, but adjustable in the range 19.2 –32A | | | | | |
| (j) | 3 No. spare capacity for future development all fitted with 63A TPN MCCBs as shown. | | | | | |
| (k) | Sealable studs for all cover plate screws and all necessary accessories | | | | | |
| (l) | 6mm perspex viewing window | | | | | |
| (m) | Heavy duty rubber lining for all the windows | | | | | |
| (n) | 415V three-phase surge diverter as Furze ESP 415, wired as shown, complete with enclosure with viewing window. | | | | | |
| (o) | Carry out comprehensive labelling of all the busbars. CT chambers, circuit breakers etc. of the above board, indicating the areas served, outgoing cable sizes etc. | | | | | |
| (p) | Comprehensive protective multiple earthing of the above board in 1500mm long 12mm diameter pure electrolytic copper earth rod deep driven to permanent moisture level, copper clamp. 240mm ² green earth lead complete with all accessories. (Note: Use parallel rods if effective earthing cannot be achieved with 1 No. rod). | | | | | |
| | Please note: The Main LV Board to be priced as an item including all its accessories as itemized above. The bidder to submit shop drawings for approval before fabrication process begins. (Note: The entire switchboard assembly to be Form 4, Type 2 i.e. totally safe with all live parts completely inaccessible on opening the outside cover) | 1 | Item | | | |
| 1.40a) | 2 X 4core 185mm ² XLPE/SWA/PVC copper cable to LV Board [Please Note: 2 cables per phase and neutral. Unit Price to be price of [4CORE 185mm sq. cable X 2. - Provisional | 30 | m. | | | |
| b) | Cable glands for above cable | 4 | No | | | |
| c) | Cable lugs for the above cable complete with hydraulic crimping | 16 | No | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | |
| 1.50 | 630A TPN automatic change-over system, with electrical and mechanical interlock. The change-over contactors to be TELE-MECANIQUE or approved equivalent, minimum rating 630A. A manual by-pass system, rated at 630A TPN should also be provided across the change-over system and it must be capable of by-passing both mains and generator supplies in alternation. All the delay timers for pre-ignition, time to load, and return to mains supply to be provided. An actual setting to be agreed upon before main switchboard is assembled. Clear indicator lamps for “mains available”, “mains on load”, “generator available”, generator on load”, together with corresponding permanent labels should also be provided. The change-over and by-pass system to be incorporated in the main switchboard assembly. | 1 | No. | | | |
| 1.60a) | 150mm diameter HG PVC ducts buried in ground.[Note: 4 parallel set of ducts to be run between each manhole.] for external power reticulation - Provisional subject to remeasurement | 150 | m. | | | |
| b) | As above but for communication ducts, provisional, subject to remeasurement | 150 | m | | | |
| c) | As above but with concrete surround | 20 | m | | | |
| 1.61 | Trenching, removal of earth, sifting of the soil, laying duct for the external cables, covering with “HATARI” tiles, backfilling, and compacting to natural ground level. | 150 | m | | | |
| 1.62 | Allow for comprehensive, phase sequency of the above installation with the generators | 1 | Item | | | |
| 1.63 | Allow for carrying out comprehensive testing of the installation as per IEE Wiring Regulation, 17 th Edition. | 1 | Item | | | |
| 1.64 | Carry out very concise and comprehensive load balancing to achieve a maximum imbalance not greater than $\pm 10\%$ between any two phases, measured at the respective main switchboards. | 1 | Item | | | |
| 1.65 | Allow for full load testing of the AVR with variable load | 1 | Item | | | |
| 1.66a) | Build 600 x 600 x 700mm deep power manhole complete with internal plaster and heavy duty EAFW steel cover. | 5 | No. | | | |
| b) | As above, but earthing manhole, with cover marked “EARTH” | 2 | No. | | | |
| c) | As 1.66a) above but communication manholes | 5 | No. | | | |
| 1.67a) | 600 x 150mm 12 gauge galvanized steel perforated cable ladders for support of cables complete with supporting frame. | 100 | m. | | | |
| b) | Earth the above cable ladder | 1 | Item | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OFQUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS
BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 1.70 | 1 set of 500A, 660V, 3-phase, 5-conductor, insulated copper busbar, to IP52 and IP54 degree of protection, conductor cross-sectional area 257mm² with 4 active conductors, with a short circuit capacity (peak/RMS) of 84/32 KA, with maximum voltage drop (mV per amp) of at 0.7, 0.8, 0.9, and 1.0 P.F. of 0.090, 0.100, 0.100, and 0.080 respectively, and an average weight in Kg/m of 12.4. The riser busbar to comprise the following:- | | | | | |
| | i) 4m 3p + N + PE straight unit copper conductors ref. 1634-0 | 6 | | | | |
| | ii) Centre Feed Unit | 1 | | | | |
| | iii) Edge-wise elbows | 12 | | | | |
| | iv) Flat-wise elbow (indoor neutral) | 12 | | | | |
| | v) Busbar-feed unit complete with 450A TPN MCCB in bonded metallic enclosure | 1 | | | | |
| | vi) 80A TPN MCCB-type pull-out tap-off units | 12 | | | | |
| | vii) 4-hour ceramic fibre fire barrier completely fitting the trunking at floor slab penetrations | 6 | | | | |
| | viii) Mechanical/Electrical junction box for expansion control | 1 | | | | |
| | ix) Any other items to complete riser busbar installation | | | | | |
| | NOTE: The busbars to be made from PURE ELECTROLYTIC COPPER. No alternatives will be accepted. Allow for performing confirmatory resistivity tests | 1 | Item | | | |
| 1.71 | Make and install 200 x 200mm wide silver plate labels with 50mm long lettering for “ELECTRICAL DUCT” and 150mm long “SPIKE” sign to be pasted to the electric ducts. | 6 | No. | | | |
| 1.72a) | 4C 300mm ² PVC/SWA/PVC copper cable from Switch-board to 500A risers, provisional, subject to remeasurement | 140 | m. | | | |
| | b) Cable glands for the above cable | 2 | No | | | |
| | c) Cable lugs for the above cable complete with hydraulic crimping | 8 | No | | | |
| 1.73a) | 600 x 150mm 12 gauge galvanized steel perforated cable trays for support of cables complete with supporting frame. | 75 | m. | | | |
| | b) Earth the above cable ladder | 1 | Item | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| 1.80 | Total B/F from previous page 8-way 200A TPN Wall-mounted purpose made front access UPS board inside the Switch Room/UPS ROOM located on the Basement Floor and for Clean power, manufactured in 14SWG galvanised mild steel sheet and finished in cream (or appropriate colour) powder coating as shown on the schematic (the other details as per Particular Specification), complete with 150A TP/N MCCB, with MCBs, earthing and all accessories including lockable cover as MK, Schneider or Merlin Gerlin, or any other approved equivalent for Common Services | 1 | No. | | | |
| | a) 40A SP MCCB's for the above board. | 12 | No | | | |
| | b) Blanking plates for unused spare ways for the above board. | 12 | No | | | |
| | c) 415V three-phase surge diverter as Furse ESP 415, wired as shown, complete with enclosure with viewing window. | 1 | No. | | | |
| | e) Carry out comprehensive labeling of all the bus bars, circuit breakers etc. of the board above, indicating the areas served, outgoing cable sizes etc. | 1 | Item | | | |
| | f) Comprehensive protective multiple earthing of the above board in 1200mm long 12mm diameter pure electrolytic copper earth rod deep driven to permanent moisture level, copper clamp. 35mm ² green earth lead complete with all accessories. (Note: Use parallel rods if effective earthing cannot be achieved with 1 No. rod). | 1 | Item | | | |
| | g) 4 core 50mm ² PVC/SWA/PVC copper cables to the DBs above | 20 | m | | | |
| | h) Cable glands for the above cable. | 2 | No. | | | |
| | i) Cable lugs for the cable above, complete with crimping | 8 | No. | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 1 – POWER SUPPLY AND DISTRIBUTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 1.90a) | 150A TP/N manual by-pass system for the UPS comprising 150A TP/N manual change-over switch, 2 No. 150A TP MCB at input and 1 No. 150A TP MCB at the output, internal wiring and a common firmly bonded metallic enclosure made from 14 gauge cream powder coated galvanised steel sheets. | 1 | No | | | |
| b) | Label the above thus: ‘ UPS POWER SUPPLY: DO NOT SWITCH OFF’ in permanent traffolyte labels, respectively including the MCB in Main Subboard Assembly. | 1 | Item | | | |
| c) | 150A local isolator in the UPS room for mains supply to and out of the UPS. | 2 | No. | | | |
| 1.91a) | 8-way TP/N Solar Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Solar PV Power. | 1 | No. | | | |
| b) | SP MCB’s for the above boards. | 12 | No | | | |
| c) | TP MCB’s for the above boards. | 0 | No | | | |
| d) | Blanking plates for unused spare ways for the above boards. | 12 | No | | | |
| e) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | |
| f) | Earth the above distribution boards. | 1 | Item | | | |
| g) | 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 100 | m | | | |
| h) | Cable glands for the above cable. | 2 | No. | | | |
| i) | Cable lugs for the cable above, complete with crimping | 8 | No. | | | |
| | | | | | | - |
| | | | | | | - |
| | | | | | | - |
| | | | | | | - |
| | | | | | | - |
| Note: The following to be included with the bid:- | | | | | | |
| 1. Detailed shop drawings of the HT Distribution, Main switchboard, busbar risers and all the sub switchboards. | | | | | | |
| Total for Bill No. 1: Main Power Supply and Distribution, C/F to Collection Page for Electrical Installations Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 2 – BASEMENT FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| 3 | Lighting | | | | | |
| 2.01a) | Lighting point 1-way switched. | 38 | No. | | | |
| b) | Lighting point 2-way switched. | 86 | No. | | | |
| 2.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | |
| (a) | 1-gang 1-way | 11 | No. | | | |
| (b) | 2-gang 1-way | 0 | No. | | | |
| (c) | 1-gang 2 way | 4 | No. | | | |
| (d) | 2-gang 2 way | 2 | No. | | | |
| (e) | PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs and walkways as Lutron Maestro or equivalent complete with wiring | 3 | No. | | | |
| 2.03 | Install permanent “DANGER” 415V labels where groups of switches have been fed by more than one phase. | 1 | No. | | | - |
| 2.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - | | | | | - |
| | (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | - |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 12 | No. | | | - |
| b) | As above but emergency version | 3 | No. | | | - |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | - |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 10 | No. | | | - |
| e) | As above but emergency version | 10 | No | | | - |
| f) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 3 | No. | | | - |
| g) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 50 | No. | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 2 – BASEMENT FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|----------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | h) JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 6 | No. | | | - |
| | i) As above but emergency version | 3 | No | | | - |
| | j) High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 9 | No | | | - |
| | k) As above but emergency version | 3 | No. | | | - |
| | l) LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 10 | m | | | - |
| | | | | | | - |
| 2.1 | <u>Power Supply</u> | | | | | - |
| 2.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 3 | No. | | | - |
| | b) SP MCB's for the above boards. | 16 | No | | | - |
| | c) Blanking plates for unused spare ways for the above boards. | 14 | No | | | - |
| | d) Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| | e) Earth the above distribution boards. | 1 | Item | | | - |
| | f) 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 60 | m | | | - |
| | g) Cable glands for the above cable. | 6 | No. | | | - |
| | h) Cable lugs for the cable above, complete with crimping | 20 | No. | | | - |
| | | | | | | - |
| 2.11a) | 8-way SP/N Power Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 1 | No. | | | - |
| | b) SP MCB's for the above boards. | 3 | No | | | - |
| | c) Blanking plates for unused spare ways for the above boards. | 5 | No | | | - |
| | d) Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| | e) Earth the above distribution boards. | 1 | Item | | | - |
| | f) 2 core 10mm ² PVC/SWA/PVC copper cables to the DBs above | 20 | m | | | - |
| | g) Cable glands for the above cable. | 2 | No. | | | - |
| | h) Cable lugs for the cable above, complete with crimping | 4 | No. | | | - |
| | | | | | | - |
| 2.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 80 | m | | | - |
| 2.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 115 | No. | | | - |
| | | | | | | - |
| | Total C/F to next page | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 2 – BASEMENT FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 2.22 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 26 | No. | | | - |
| b) | Twin 32A TPN Industrial socket outlets complete with wiring in 6x4.0mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 1 | No. | | | - |
| 2.23 | Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 80 | m | | | - |
| 2.24a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 50 | m | | | - |
| b) | 300x50mm plastic factory made corner bends for the trunking above. | 12 | No. | | | - |
| c) | Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | - |
| d) | Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 20 | m | | | - |
| 2.25a) | Punched outlet plates on the trunking for twin socket outlets. | 24 | No | | | - |
| b) | Punched outlet plates on the trunking for twin Data/voice outlets. | 12 | No | | | - |
| 2.26a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 12 | No. | | | - |
| b) | Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 12 | No. | | | - |
| c) | Supply and install 5mm high permanent red trafolyte labels marked “UPS ONLY” for clean line power sockets. | 12 | No. | | | - |
| d) | Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 12 | No | | | - |
| e) | Additional fused 13A non-standard unbreakable top plugs for clients keeping | 3 | No. | | | - |
| 2.27 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 4 | No | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 2 – BASEMENT FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 2.28 | Outlet for sump pump, comprising box, concealed PVC conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A SPN Isolators | 1 | No. | | | - |
| 2.29 | 20A SPN MCB in the sub-board for sump pump | 1 | No. | | | - |
| 2.30a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 1 | No | | | - |
| b) | Heavy-duty micro switches for the above | 1 | No | | | - |
| 2.31a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 1 | No. | | | - |
| b) | 20A SP AVS for the above units | 1 | No. | | | - |
| Total for Bill No. 2: Basement Floor –C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OFQUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 3 – GROUND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| | 3 Lighting | | | | | |
| 3.01a) | Lighting point 1-way switched. | 140 | No. | | | - |
| b) | Lighting point 2-way switched. | 110 | No. | | | - |
| | | | | | | - |
| 3.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | - |
| | (a) 1-gang 1-way | 26 | No. | | | - |
| | (b) 2-gang 1-way | 1 | No. | | | - |
| | (c) 1-gang 2 way | 34 | No. | | | - |
| | (d) 2-gang 2 way | 2 | No. | | | - |
| | | | | | | - |
| | (e) PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs and walkways as Lutron Maestro or equivalent complete with wiring | 13 | No. | | | - |
| 3.03 | Install permanent “DANGER” 415V labels where groups of switches have been fed by more than one phase. | 1 | No. | | | - |
| | | | | | | - |
| 3.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - | | | | | - |
| | (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | - |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 60 | No. | | | |
| b) | As above but emergency version | 10 | No. | | | |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | |
| | | | | | | - |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 4 | No. | | | |
| | | | | | | |
| e) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 8 | No. | | | |
| f) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 3 | No. | | | |
| g) | JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 4 | No. | | | |
| h) | As above but emergency version | 2 | No | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 3 – GROUND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| i) | High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 85 | No | | | - |
| j) | As above but emergency version | 20 | No. | | | - |
| k) | Surface mounted batten in extruded aluminum with ABS end caps housing and opal polycarbonate diffuser c/w 8W LED lamp as DISANO 420-Rigo LED cat no. 214565-54 or approved equivalent (type LV) | 9 | No | | | - |
| l) | Surface mounted Bulkhead with die cast aluminum housing and opal polycarbonate diffuser c/w 10W LED lamp as JCC NITE LED wall sphere cat no. JC 39418 or approved equivalent (type M) | 17 | No | | | - |
| m) | 6A (fused) photocell unit as Thorn QPK for the above lights or any other approved equivalent. | 1 | No | | | - |
| n) | 30A SP/N contactor (as Telemecanique) for the above or any approved equivalent | 1 | No | | | - |
| o) | Surface mounted 180mm Diameter press steel housing and frosted opal glass diffuser as JCC RIGA CEILING cat no. JC 52016CH or approved equivalent. (Type C1) | 15 | No | | | |
| p) | APOLLO CDM-TS 150 AS FOSNOVA LED WITH EXTRUDED ALUMINIUM HOUSING AND REFLECTIVE SURFACE WITH DIFFUSER AND HUMIDITY RESISTANT AND ELECTRIC GEAR AS WALLWASH LIGHTS (type F) | 14 | No | | | |
| q) | 6A (fused) photocell unit as Thorn QPK for the above lights or any other approved equivalent. | 2 | No | | | |
| r) | 30A SP/N contactor (as Telemecanique) for the above or any approved equivalent | 1 | No | | | |
| s) | Philips Marker LED 3W for entrance step lights as Type 3 | 6 | No | | | |
| t) | A pendant chandelier light fixture with brushed chrome base, articulated arms, and opal mat glass complete with 12No. Upside down wine glasses LED lamps and to be approved | 2 | No | | | |
| u) | Wall mounted high temperature resistant thermoplastic light fitting complete with a shere-opal polycarbonate diffuser as Disano Argostar wall Fosnova or approved equivalent Type W | 8 | No | | | |
| v) | Ceiling Pendant as Pierlite G9 3 light with brushed chrome and articulated arms and opal matt glass complete with LED lamp as Type B | 4 | No | | | |
| w) | LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 60 | m | | | - |
| 3.05a) | Establish an outlet for 'JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY' sign illumination comprising box, concealed H.G. PVC conduit, wiring in 3x1.5mm ² SC-PVC-CU cables and all accessories as a lighting point through photocell. | 1 | No | | | |
| b) | 5A (fused) photocell unit as Thorn QPK for the above signs, or any other approved equivalent. | 1 | No | | | |
| c) | 30A SP/N contactor (as Telemecanique) for the above or any approved equivalent | 1 | No | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 3 – GROUND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 3.1 | <u>Power Supply</u> | | | | | - |
| 3.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 4 | No. | | | |
| b) | SP MCB's for the above boards. | 50 | No | | | |
| c) | Blanking plates for unused spare ways for the above boards. | 70 | No | | | |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | |
| e) | Earth the above distribution boards. | 1 | Item | | | |
| f) | 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 60 | m | | | |
| g) | Cable glands for the above cable. | 8 | No. | | | |
| h) | Cable lugs for the cable above, complete with crimping | 32 | No. | | | |
| 3.11a) | 8-way SP/N Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The CU to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Clean Power | 2 | No. | | | |
| b) | SP MCB's for the above board. | 11 | No | | | |
| c) | Blanking plates for unused spare ways for the above board. | 5 | No | | | |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | |
| e) | Earth the above board. | 1 | Item | | | |
| f) | 2 core 10mm ² PVC/SWA/PVC copper cables to the Board above | 30 | m | | | |
| g) | Cable glands for the above cable. | 4 | No. | | | |
| h) | Cable lugs for the cable above, complete with crimping | 8 | No. | | | |
| 3.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 90 | m | | | - |
| 3.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 140 | No. | | | |
| 3.22a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 3 | No | | | |
| b) | Heavy-duty micro switches for the above | 3 | No | | | - |
| 3.23 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 30 | No. | | | |
| 3.24 | Dia. 32mm H.G PVC conduits buried in floor slab | 100 | m | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 3 – GROUND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 3.25a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 350 | m | | | |
| b) | 300x50mm plastic factory made corner bends for the trunking above. | 90 | No. | | | |
| c) | Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | |
| d) | Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 50 | m | | | |
| 3.26a) | Punched outlet plates on the trunking for twin socket outlets. | 160 | No | | | |
| b) | Punched outlet plates on the trunking for twin Data/voice outlets. | 80 | No | | | |
| 3.27a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 80 | No. | | | |
| b) | Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 80 | No. | | | |
| c) | Supply and install 5mm high permanent red trafolyte labels marked "UPS ONLY" for clean line power sockets. | 80 | No. | | | - |
| d) | Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 80 | No | | | |
| e) | Additional fused 13A non-standard unbreakable top plugs for clients keeping | 10 | No. | | | - |
| f) | Power Floorbox complete with 4 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 4 No. telephone/data outlet plates as per details shown on the drawings | 7 | No. | | | |
| 3.28 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 3 | No | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 3 – GROUND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|--|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 3.29 | Outlet point for water heater/ hand drier/ extract fans/ staircase Pressurization comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 8 | No | | | |
| 3.30a) | Outlet for cooker control unit comprising wiring in 3x6.0mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lamp as MK or approved equivalent. | 2 | No. | | | |
| b) | 45A DP cooker connector unit with wiring in 3 x 6.0 mm ² SC-PVC-CU cables, and Dia. 25mm HG conduit link to the above. | 2 | No. | | | |
| 3.31 | Outlet point for kitchen hood comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | - |
| 3.32 | Outlet for twin 15A industrial sockets comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including top plug | 2 | No. | | | |
| 3.33a) | Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or any approved equivalent | 3 | No | | | |
| b) | 5A “Hi-volt” guard for TV as Sollatek or any other approved equivalent. | 3 | No | | | |
| c) | TV Standard Decoder for free to air channels complete with 2 way signal splitter switch and signal amplifier, and 100m signal cable. (TV Client supplied). Decoder make to be approved by Communications Authority. | 1 | No | | | |
| 3.34 | Outlet for sensor taps/urinals comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories. (The sensor taps/urinals to be wired on UPS) | 9 | No. | | | - |
| 3.35 | Outlet for sculpture/fountain comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories. | 2 | No. | | | |
| 3.36a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | |
| b) | 20A SP AVS for the above units | 2 | No. | | | - |
| Total for Bill No. 3: Ground Floor C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 4 – FIRST FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| 4 | Lighting | | | | | |
| 4.01a) | Lighting point 1-way switched. | 137 | No. | | | |
| b) | Lighting point 2-way switched. | 90 | No. | | | |
| 4.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | |
| (a) | 1-gang 1-way | 29 | No. | | | |
| (b) | 2-gang 1-way | 3 | No. | | | |
| (c) | 1-gang 2 way | 21 | No. | | | |
| (d) | 2-gang 2 way | 2 | No. | | | |
| (e) | PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs and walkways as Lutron Maestro or equivalent complete with wiring | 12 | No. | | | |
| 4.03 | Install permanent “DANGER” 415V labels where groups of switches have been fed by more than one phase. | 2 | No. | | | - |
| 4.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 40 | No. | | | |
| b) | As above but emergency version | 10 | No. | | | |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 2 | No. | | | |
| e) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 5 | No. | | | |
| f) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 1 | No. | | | |
| g) | JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 5 | No. | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 4 – FIRST FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|----------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| h) | As above but emergency version | 3 | No | | | |
| i) | High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 90 | No | | | |
| j) | As above but emergency version | 25 | No. | | | |
| k) | Surface mounted batten in extruded aluminum with ABS end caps housing and opal polycarbonate diffuser c/w 8W LED lamp as DISANO 420-Rigo LED cat no. 214565-54 or approved equivalent (type LV) | 9 | No | | | |
| l) | Surface mounted 180mm Diameter press steel housing and frosted opal glass diffuser as JCC RIGA CEILING cat no. JC 52016CH or approved equivalent. (Type C1) | 15 | No | | | - |
| u) | Wall mounted high temperature resistant thermoplastic light fitting complete with a shere-opal polycarbonate diffuser as Disano Argostar wall Fosnova or approved equivalent Type W | 8 | No | | | |
| v) | Ceiling Pendant as Pierlite G9 3 light with brushed chrome and articulated arms and opal matt glass complete with LED lamp as Type B | 4 | No | | | |
| w) | LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 60 | m | | | - |
| 4.1 | Power Supply | | | | | - |
| 4.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 3 | No. | | | |
| b) | SP MCB's for the above boards. | 46 | No | | | |
| c) | Blanking plates for unused spare ways for the above boards. | 44 | No | | | |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | |
| e) | Earth the above distribution boards. | 1 | Item | | | |
| f) | 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 45 | m | | | |
| g) | Cable glands for the above cable. | 6 | No. | | | |
| h) | Cable lugs for the cable above, complete with crimping | 24 | No. | | | |
| 4.11a) | 8-way SP/N Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The CU to be as Schneider Electric or Merlin Gerin or any other approved equivalent for Clean Power | 2 | No. | | | |
| b) | SP MCB's for the above board. | 12 | No | | | - |
| | Total C/F to next page | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 4 – FIRST FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| c) | Blanking plates for unused spare ways for the above board. | 4 | No | | | |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | |
| e) | Earth the above board. | 1 | Item | | | |
| f) | 2 core 10mm ² PVC/SWA/PVC copper cables to the Board above | 30 | m | | | |
| g) | Cable glands for the above cable. | 4 | No. | | | |
| h) | Cable lugs for the cable above, complete with crimping | 8 | No. | | | |
| 4.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 70 | m | | | |
| 4.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 120 | No. | | | |
| 4.22a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 2 | No | | | - |
| b) | Heavy-duty micro switches for the above | 2 | No | | | |
| 4.23 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 10 | No. | | | |
| 4.24 | Dia. 32mm H.G PVC conduits buried in floor slab | 50 | m | | | |
| 4.25a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 350 | m | | | |
| b) | 300x50mm plastic factory made corner bends for the trunking above. | 100 | No. | | | - |
| c) | Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | |
| d) | Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 90 | m | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 4 – FIRST FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | | | | | | - |
| 4.26a) | Punched outlet plates on the trunking for twin socket outlets. | 160 | No | | | |
| b) | Punched outlet plates on the trunking for twin Data/voice outlets. | 80 | No | | | |
| 4.27a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 80 | No. | | | |
| b) | Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 80 | No. | | | |
| c) | Supply and install 5mm high permanent red trafollyte labels marked “UPS ONLY” for clean line power sockets. | 80 | No. | | | - |
| d) | Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 80 | No | | | - |
| e) | Additional fused 13A non-standard unbreakable top plugs for clients keeping | 10 | No. | | | - |
| f) | Power Floorbox complete with 4 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 4 No. telephone/data outlet plates as per details shown on the drawings | 9 | No. | | | - |
| 4.28 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 3 | No | | | - |
| 4.29 | Outlet point for water heater/ hand drier/ extract fans/ staircase Pressurization comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 13 | No | | | |
| 4.30a) | Outlet for cooker control unit comprising wiring in 3x6.0mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lamp as MK or approved equivalent. | 2 | No. | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 4 – FIRST FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | b) 45A DP cooker connector unit with wiring in 3 x 6.0 mm ² SC-PVC-CU cables, and Dia. 25mm HG conduit link to the above. | 2 | No. | | | - |
| 4.31 | Outlet point for kitchen hood comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | |
| 4.32 | Outlet for twin 15A industrial sockets comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including top plug | 2 | No. | | | |
| 4.33a) | Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or any approved equivalent | 2 | No | | | |
| | b) 5A “Hi-volt” guard for TV as Sollatek or any other approved equivalent. | 2 | No | | | - |
| | c) TV Standard Decoder for free to air channels complete with 2 way signal splitter switch and signal amplifier, and 100m signal cable. (TV Client supplied). Decoder make to be approved by Communications Authority. | 1 | No | | | - |
| 4.34 | Outlet for sensor taps/urinals comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories. (The sensor taps/urinals to be wired on UPS) | 12 | No. | | | - |
| 4.35a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 4 | No. | | | |
| | b) 20A SP AVS for the above units | 4 | No. | | | - |
| Total for Bill No. 4: First Floor C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 5 – SECOND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| | 5 Lighting | | | | | |
| 5.01a) | Lighting point 1-way switched. | 130 | No. | | | |
| b) | Lighting point 2-way switched. | 70 | No. | | | |
| 5.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | |
| (a) | 1-gang 1-way | 35 | No. | | | |
| (b) | 2-gang 1-way | 2 | No. | | | |
| (c) | 1-gang 2 way | 15 | No. | | | |
| (d) | 2-gang 2 way | 4 | No. | | | |
| (e) | PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs and walkways as Lutron Maestro or equivalent complete with wiring | 12 | No. | | | |
| 5.03 | Install permanent “DANGER” 415V labels where groups of switches have been fed by more than one phase. | 1 | No. | | | |
| 5.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - | | | | | - |
| | (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | - |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 40 | No. | | | |
| b) | As above but emergency version | 10 | No. | | | |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 1 | No. | | | - |
| e) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 4 | No. | | | - |
| f) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 6 | No. | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 5 – SECOND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| g) | JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 5 | No. | | | |
| h) | As above but emergency version | 3 | No | | | |
| i) | High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 90 | No | | | |
| j) | As above but emergency version | 25 | No. | | | |
| k) | Surface mounted batten in extruded aluminum with ABS end caps housing and opal polycarbonate diffuser c/w 8W LED lamp as DISANO 420-Rigo LED cat no. 214565-54 or approved equivalent (type LV) | 7 | No | | | |
| l) | Surface mounted 180mm Diameter press steel housing and frosted opal glass diffuser as JCC RIGA CEILING cat no. JC 52016CH or approved equivalent. (Type C1) | 11 | No | | | |
| m) | LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 60 | m | | | - |
| 5.1 | Power Supply | | | | | - |
| 5.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 3 | No. | | | - |
| b) | SP MCB's for the above boards. | 43 | No | | | - |
| c) | Blanking plates for unused spare ways for the above boards. | 47 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| e) | Earth the above distribution boards. | 1 | Item | | | - |
| f) | 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 45 | m | | | - |
| g) | Cable glands for the above cable. | 6 | No. | | | - |
| h) | Cable lugs for the cable above, complete with crimping | 24 | No. | | | - |
| 5.11a) | 8-way SP/N Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The CU to be as Schneider Electric or Merlin Gerin or any other approved equivalent for Clean Power | 2 | No. | | | - |
| b) | SP MCB's for the above board. | 12 | No | | | - |
| c) | Blanking plates for unused spare ways for the above board. | 4 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| e) | Earth the above board. | 1 | Item | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 5 – SECOND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | | | | | | - |
| f) | 2 core 10mm ² PVC/SWA/PVC copper cables to the Board above | 30 | m | | | |
| g) | Cable glands for the above cable. | 4 | No. | | | |
| h) | Cable lugs for the cable above, complete with crimping | 8 | No. | | | |
| 5.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 70 | m | | | |
| 5.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 113 | No. | | | |
| 5.22a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 2 | No | | | |
| b) | Heavy-duty micro switches for the above | 2 | No | | | - |
| 5.23 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 20 | No. | | | |
| 5.24 | Dia. 32mm H.G PVC conduits buried in floor slab | 70 | m | | | |
| 5.25a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 300 | m | | | |
| b) | 300x50mm plastic factory made corner bends for the trunking above. | 90 | No. | | | |
| c) | Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | |
| d) | Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 90 | m | | | |
| 5.26a) | Punched outlet plates on the trunking for twin socket outlets. | 170 | No | | | |
| b) | Punched outlet plates on the trunking for twin Data/voice outlets. | 85 | No | | | |
| 5.27a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 85 | No. | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 5 – SECOND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | b) Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 85 | No. | | | |
| | c) Supply and install 5mm high permanent red trafolyte labels marked “UPS ONLY” for clean line power sockets. | 85 | No. | | | |
| | d) Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 85 | No | | | |
| | e) Additional fused 13A non-standard unbreakable top plugs for clients keeping | 10 | No. | | | |
| | f) Power Floorbox complete with 4 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 4 No. telephone/data outlet plates as per details shown | 8 | No. | | | |
| 5.28 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 3 | No | | | |
| 5.29 | Outlet point for water heater/ hand drier/ extract fans/ staircase Pressurization comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 7 | No | | | |
| 5.30a) | Outlet for cooker control unit comprising wiring in 3x6.0mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lamp as MK or approved equivalent. | 1 | No. | | | |
| | b) 45A DP cooker connector unit with wiring in 3 x 6.0 mm ² SC-PVC-CU cables, and Dia. 25mm HG conduit link to the above. | 1 | No. | | | |
| 5.31 | Outlet point for kitchen hood comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 1 | No. | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 5 – SECOND FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|--|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | | | | | | - |
| 5.32 | Outlet for twin 15A industrial sockets comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including top plug | 1 | No. | | | |
| 5.33a) | Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or any approved equivalent | 2 | No | | | |
| b) | 5A “Hi-volt” guard for TV as Sollatek or any other approved equivalent. | 2 | No | | | |
| c) | TV Standard Decoder for free to air channels complete with 2 way signal splitter switch and signal amplifier, and 100m signal cable. (TV Client supplied). Decoder make to be approved by Communications Authority. | 1 | No | | | |
| 5.34 | Outlet for sensor taps/urinals comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories. (The sensor taps/urinals to be wired on UPS) | 10 | No. | | | |
| 5.35a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | |
| b) | 20A SP AVS for the above units | 2 | No. | | | |
| Total for Bill No. 5: Second Floor C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 6 – THIRD FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| | 6 Lighting | | | | | |
| 6.01a) | Lighting point 1-way switched. | 130 | No. | | | |
| b) | Lighting point 2-way switched. | 80 | No. | | | |
| 6.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | |
| (a) | 1-gang 1-way | 35 | No. | | | |
| (b) | 2-gang 1-way | 3 | No. | | | |
| (c) | 1-gang 2 way | 20 | No. | | | |
| (d) | 2-gang 2 way | 4 | No. | | | |
| (e) | PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs and walkways as Lutron Maestro or equivalent complete with wiring | 12 | No. | | | |
| 6.03 | Install permanent “DANGER” 415V labels where groups of switches have been fed by more than one phase. | 1 | No. | | | - |
| 6.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 38 | No. | | | |
| b) | As above but emergency version | 10 | No. | | | |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 4 | No. | | | - |
| e) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 4 | No. | | | |
| f) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 5 | No. | | | |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 6 – THIRD FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| g) | JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 5 | No. | | | |
| h) | As above but emergency version | 3 | No | | | |
| i) | High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 85 | No | | | |
| j) | As above but emergency version | 25 | No. | | | |
| k) | Surface mounted batten in extruded aluminum with ABS end caps housing and opal polycarbonate diffuser c/w 8W LED lamp as DISANO 420-Rigo LED cat no. 214565-54 or approved equivalent (type LV) | 8 | No | | | |
| l) | Surface mounted 180mm Diameter press steel housing and frosted opal glass diffuser as JCC RIGA CEILING cat no. JC 52016CH or approved equivalent. (Type C1) | 12 | No | | | |
| m) | Wall mounted high temperature resistant thermoplastic light fitting complete with a shere-opal polycarbonate diffuser as Disano Argostar wall Fosnova or approved equivalent Type W | 5 | No | | | |
| n) | Ceiling Pendant as Pierlite G9 3 light with brushed chrome and articulated arms and opal matt glass complete with LED lamp as Type B | 2 | No | | | |
| o) | LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 60 | m | | | - |
| 6.1 | Power Supply | | | | | |
| 6.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 4 | No. | | | |
| b) | SP MCB's for the above boards. | 47 | No | | | |
| c) | Blanking plates for unused spare ways for the above boards. | 73 | No | | | |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| e) | Earth the above distribution boards. | 1 | Item | | | - |
| f) | 4 core 25mm ² PVC/SWA/PVC copper cables to the DBs above | 45 | m | | | - |
| g) | Cable glands for the above cable. | 8 | No. | | | - |
| h) | Cable lugs for the cable above, complete with crimping | 32 | No. | | | - |
| 6.11a) | 8-way SP/N Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The CU to be as Schneider Electric or Merlin Gerin or any other approved equivalent for Clean Power | 2 | No. | | | - |
| b) | SP MCB's for the above board. | 6 | No | | | - |
| c) | Blanking plates for unused spare ways for the above board. | 10 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 6 – THIRD FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | e) Earth the above board. | 1 | Item | | | - |
| | f) 2 core 10mm ² PVC/SWA/PVC copper cables to the Board above | 30 | m | | | - |
| | g) Cable glands for the above cable. | 4 | No. | | | - |
| | h) Cable lugs for the cable above, complete with crimping | 8 | No. | | | - |
| | | | | | | - |
| 6.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 70 | m | | | - |
| 6.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 130 | No. | | | - |
| 6.22a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 2 | No | | | - |
| | b) Heavy-duty micro switches for the above | 2 | No | | | - |
| 6.23 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 28 | No. | | | - |
| 6.24 | Dia. 32mm H.G PVC conduits buried in floor slab | 70 | m | | | - |
| 6.25 a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 300 | m | | | - |
| | b) 300x50mm plastic factory made corner bends for the trunking above. | 90 | No. | | | - |
| | c) Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | - |
| | d) Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 90 | m | | | - |
| 6.26 a) | Punched outlet plates on the trunking for twin socket outlets. | 170 | No | | | - |
| | b) Punched outlet plates on the trunking for twin Data/voice outlets. | 85 | No | | | - |
| 6.27 a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 85 | No. | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 6 – THIRD FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| b) | Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 85 | No. | | | |
| c) | Supply and install 5mm high permanent red trafolyte labels marked “UPS ONLY” for clean line power sockets. | 85 | No. | | | |
| d) | Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 85 | No | | | |
| e) | Additional fused 13A non-standard unbreakable top plugs for clients keeping | 10 | No. | | | |
| f) | Power Floorbox complete with 4 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 4 No. telephone/data outlet plates as per details shown on the drawings | 6 | No. | | | - |
| 6.28 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 3 | No | | | |
| 6.29 | Outlet point for water heater/ hand drier/ extract fans/ staircase Pressurization comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 7 | No | | | |
| 6.30a) | Outlet for cooker control unit comprising wiring in 3x6.0mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lamp as MK or approved equivalent. | 2 | No. | | | |
| b) | 45A DP cooker connector unit with wiring in 3 x 6.0 mm ² SC-PVC-CU cables, and Dia. 25mm HG conduit link to the above. | 2 | No. | | | - |
| 6.31 | Outlet point for kitchen hood comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 6 – THIRD FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 6.32 | Outlet for twin 15A industrial sockets comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including top plug | 2 | No. | | | - |
| 6.33a) | Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or any approved equivalent | 2 | No | | | - |
| b) | 5A “Hi-volt” guard for TV as Sollatek or any other approved equivalent. | 2 | No | | | - |
| c) | TV Standard Decoder for free to air channels complete with 2 way signal splitter switch and signal amplifier, and 100m signal cable. (TV Client supplied). Decoder make to be approved by Communications Authority. | 1 | No | | | - |
| 6.34 | Outlet for sensor taps/urinals comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories. (The sensor taps/urinals to be wired on UPS) | 11 | No. | | | - |
| 6.35a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 2 | No. | | | - |
| b) | 20A SP AVS for the above units | 2 | No. | | | - |
| Total for Bill No. 6: Third Floor C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 7- FOURTH FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable. PLEASE NOTE ALL LED LIGHT FITTINGS TO BE RATED 220-240V AC | | | | | |
| 7 | Lighting | | | | | |
| 7.01a) | Lighting point 1-way switched. | 70 | No. | | | |
| b) | Lighting point 2-way switched. | 165 | No. | | | |
| 7.02 | 5 A white moulded switch plates as MK or Crabtree or any other approved equivalent: - | | | | | |
| (a) | 1-gang 1-way | 20 | No. | | | |
| (b) | 2-gang 1-way | 4 | No. | | | |
| (c) | 1-gang 2 way | 24 | No. | | | |
| (d) | 2-gang 2 way | 4 | No. | | | |
| (e) | 3-gang 2 way | 2 | No. | | | |
| (f) | PIR Lighting occupancy sensor with manual override switch, 360degrees and minimum 20metres sensing range for washrooms, stairs, conference, senate chamber and walkways as Lutron Maestro or equivalent complete with wiring | 20 | No. | | | |
| 7.03 | Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase. | 2 | No. | | | |
| 7.04 | Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: - (Note: All fittings to be fitted with High Frequency control gear. All LED fittings to be rated 220-240VAC) | | | | | - |
| a) | Recessed horizontal 390mm Diameter Downlighter c/w TC 22W T5 lamp,an opal polycarbonate diffuser as Fosnova cat no. 22089410-00 or approved equivalent. (Type C) | 60 | No. | | | - |
| b) | As above but emergency version | 25 | No. | | | - |
| c) | JCC NiteLED Wall Sphere low energy light 10W with Die Cast Aluminium AS JC39418 or approved equivalent. (Type X) | 3 | No | | | - |
| d) | Extruded aluminium frame housing with polycarbonate diffuser omplete with 61W LED lamp as cat no. JCC Skylinee 5000 cat no. JC 71302 or approved equivalent (type 4) | 4 | No. | | | - |
| e) | 1.8W Exit Emergency Light Complete With Vandal Resistant, Anti Yellowing Grey Polycarbonate As Disano 618 Safety S.E Version Cat No. 112561-0066 with an autonomy of 3hrs. | 8 | No. | | | - |
| f) | Injection moulded, vandal, self extinguishing, UV stabilized grey polycarbonate high resistance housing with injection moulded self extinguishing UV stabilized clear polycarbonate prismatic diffuser complete with 25W LED lamp (type 5C) | 2 | No. | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 7– FOURTH FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| g) | JCC Forento IP44 and IP65 HF Low Energy Surface Fitting as JC23006 or approved equivalent as Type A. | 5 | No. | | | |
| h) | As above but emergency version | 3 | No | | | |
| i) | High Performance 600x600mm LED flat Panel c/w 44W LED lamp, extruded aluminium frame with opal polycarbonate diffuser cat no. JC71277 or approved equivalent | 50 | No | | | |
| j) | As above but emergency version | 12 | No. | | | |
| k) | Surface mounted batten in extruded aluminum with ABS end caps housing and opal polycarbonate diffuser c/w 8W LED lamp as DISANO 420-Rigo LED cat no. 214565-54 or approved equivalent (type LV) | 9 | No | | | |
| l) | Surface mounted 180mm Diameter press steel housing and frosted opal glass diffuser as JCC RIGA CEILING cat no. JC 52016CH or approved equivalent. (Type C1) | 20 | No | | | |
| m) | Wall mounted high temperature resistant thermoplastic light fitting complete with a shere-opal polycarbonate diffuser as Disano Argostar wall Fosnova or approved equivalent Type W | 28 | No | | | |
| n) | Ceiling Pendant as Pierlite G9 3 light with brushed chrome and articulated arms and opal matt glass complete with LED lamp as Type B | 7 | No | | | |
| o) | LED Strip light complete with control gear. Default colour Amber and to be approved by Architect. | 60 | m | | | - |
| 7.1 | Power Supply | | | | | - |
| 7.10a) | 10-way TP/N Power Distribution Board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Raw Power. | 3 | No. | | | - |
| b) | SP MCB's for the above boards. | 43 | No | | | - |
| c) | Blanking plates for unused spare ways for the above boards. | 47 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| e) | Earth the above distribution boards. | 1 | Item | | | - |
| f) | 4 core 25mm² PVC/SWA/PVC copper cables to the DBs above | 45 | m | | | - |
| g) | Cable glands for the above cable. | 6 | No. | | | - |
| h) | Cable lugs for the cable above, complete with crimping | 24 | No. | | | - |
| 7.11a) | 8-way SP/N Consumer Unit complete with 63A SP/N integral isolator and all accessories including lockable cover. The CU to be as Schneider Electric or Merlin Gerlin or any other approved equivalent for Clean Power | 2 | No. | | | - |
| b) | SP MCB's for the above board. | 10 | No | | | - |
| c) | Blanking plates for unused spare ways for the above board. | 6 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 7- FOURTH FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | | | | | | - |
| | e) Earth the above board. | 1 | Item | | | - |
| | f) 2 core 10mm ² PVC/SWA/PVC copper cables to the Board above | 30 | m | | | - |
| | g) Cable glands for the above cable. | 4 | No. | | | - |
| | h) Cable lugs for the cable above, complete with crimping | 8 | No. | | | - |
| | | | | | | - |
| 7.2 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 70 | m | | | - |
| 7.21 | Outlet for CCTV/ security alarm/ fire alarm points comprising box, concealed in PVC conduit, draw wire and square blanking cover. | 90 | No. | | | - |
| 7.22a) | Outlet for electric door locks comprising wiring in 3x2.5mm ² SC-PVC-CU cables, box, concealed conduit links and all accessories including card reader. | 3 | No | | | - |
| | | | | | | - |
| | b) Heavy-duty micro switches for the above | 3 | No | | | - |
| | | | | | | - |
| 7.23 | Twin 13A socket outlets complete with wiring in 6x2.5mm ² PVC-SC-CU cables inside concealed conduits for raw power. The socket outlets to be MK, Crabtree or any other approved equivalent | 20 | No. | | | - |
| 7.24 | Dia. 32mm H.G PVC conduits buried in floor slab | 50 | m | | | - |
| 7.25 a) | 300x50mm cream heavy duty plastic angular clip-on 3-compartment trunking as per details shown complete with cover, screws etc | 100 | m | | | - |
| | | | | | | - |
| | b) 300x50mm plastic factory made corner bends for the trunking above. | 40 | No. | | | - |
| | | | | | | - |
| | c) Carry out bonding throughout the entire length of the above trunking in 6mm ² green PVC insulated copper cables | 1 | Item | | | - |
| | | | | | | - |
| | d) Dia. 32mm H.G PVC conduits buried in floor slab (Provisional) | 50 | m | | | - |
| 7.26 a) | Punched outlet plates on the trunking for twin socket outlets. | 100 | No | | | - |
| | | | | | | - |
| | b) Punched outlet plates on the trunking for twin Data/voice outlets. | 50 | No | | | - |
| | | | | | | - |
| 7.27 a) | Twin 13A standard white socket outlet as MK or Crabtree or any other approved equivalent, complete with ring wiring in 6x2.5mm ² PVC-SC-CU cables inside trunking for raw power | 50 | No. | | | - |
| | | | | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 7– FOURTH FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| b) | Twin 13A non standard red socket outlets , as MK or Crabtree or any other approved equivalent, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm ² PVC-SC-CU cables and fused unbreakable 13A 3-pin non standard top plugs inside the trunking. | 50 | No. | | | - |
| c) | Supply and install 5mm high permanent red trafolyte labels marked “UPS ONLY” for clean line power sockets. | 50 | No. | | | - |
| d) | Twin data/telephone faceplates in trunking complete with box draw-wire and square blanking cover for RJ45 terminations | 50 | No | | | - |
| e) | Additional fused 13A non-standard unbreakable top plugs for clients keeping | 5 | No. | | | - |
| f) | Power Floorbox complete with 4 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 4 No. telephone/data outlet plates as per details shown on the drawings | 14 | No. | | | - |
| g) | Power Tilt-up Tabletop boxes complete with 1 No. twin normal socket outlets wiring in 6x2.5mm ² PVC-SC-PVC cables, 1 No. twin nonstandard socket outlets for computer points with neon lights wiring in ring 6x2.5mm ² PVC-SC-PVC cables and 1 No. telephone/data outlet plates | 30 | No. | | | - |
| 7.28 | 450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc. | 3 | No | | | - |
| 7.29 | Outlet point for water heater/ hand drier/ extract fans/ staircase Pressurization comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 9 | No | | | - |
| 7.30a) | Outlet for cooker control unit comprising wiring in 3x6.0mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lamp as MK or approved equivalent. | 1 | No. | | | - |
| b) | 45A DP cooker connector unit with wiring in 3 x 6.0 mm ² SC-PVC-CU cables, and Dia. 25mm HG conduit link to the above. | 1 | No. | | | - |
| | | | | | | - |
| Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 7– FOURTH FLOOR

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|--|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 7.31 | Outlet point for kitchen hood comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 1 | No. | | | - |
| 7.32 | Outlet for twin 15A industrial sockets comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including top plug | 1 | No. | | | - |
| 7.33a) | Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or any approved equivalent | 4 | No | | | - |
| b) | 5A “Hi-volt” guard for TV as Sollatek or any other approved equivalent. | 4 | No | | | - |
| c) | TV Standard Decoder for free to air channels complete with 2 way signal splitter switch and signal amplifier, and 100m signal cable. (TV Client supplied). Decoder make to be approved by Communications Authority. | 2 | No | | | - |
| 7.34 | Outlet for sensor taps/urinals comprising wiring in 3x2.5mm ² SC-PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories.(The sensor taps/urinals to be wired on UPS) | 11 | No. | | | - |
| 7.35a) | Outlet point for indoor AC unit comprising 20mm diameter conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree or any other approved equivalent. | 14 | No. | | | - |
| b) | 20A SP AVS for the above units | 14 | No. | | | - |
| Total for Bill No. 7: Fourth Floor C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 8: POWER SUPPLY TO AC UNITS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|--|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| 8.01 | Outlet for AC outdoor unit at Rooftop comprising box, wiring in 4core 95mm ² PVC/SWA/PVC Copper cables, 100mm H.G PVC conduits and 150A TPN isolator as MK or Crabtree or approved equivalent. | 1 | No | | | |
| 8.02a) | 150A TPN motorized MCCB in Main LV board for Roof top AC Units -Provisional | 1 | No. | | | |
| b) | Label the above MCCB panel thus: "SUPPLY TO AIR CONDITIONING UNIT" in red 10mm high permanent traffolyte labels. | 1 | Item | | | |
| 8.04a) | 6-way TP/N Power Distribution Board complete with 200A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider Electric or Merlin Gerin or any other approved equivalent . | 1 | No. | | | |
| b) | 63A TP MCB's for the above board | 3 | No | | | - |
| c) | Blanking plates for unused spare ways for the above boards. | 3 | No | | | - |
| d) | Carry out complete permanent labeling for all the sub-circuits in the board above | 1 | Item | | | - |
| e) | Earth the above distribution boards. | 1 | Item | | | - |
| f) | 4 core 95mm ² PVC/SWA/PVC copper cables to the DB above. | 10 | m | | | - |
| g) | Cable glands for the above cable. | 4 | No. | | | - |
| h) | Cable lugs for the cable above, complete with crimping | 16 | No. | | | - |
| 8.05a) | 63A TPN Local Isolator for Roof top AC Units as Telemecanique or approved equivalent. | 3 | No. | | | |
| b) | 4C 16mm ² PVC/SWA/PVC copper cable to local isolators | 20 | m | | | |
| c) | Cable glands for the above cable. | 10 | m. | | | |
| d) | Cable lugs for the above cable. | 40 | No. | | | |
| 8.06 | 100x50mm white stove enameled trunking, single-compartment, complete with cover, screws etc for the sub mains cables above -Provisional | 20 | m | | | |
| 8.07 | Dia. 32mm HG PVC conduits in floor slab (provisional) | 30 | m | | | - |
| Total for Bill No. 8: Supply to AC C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO.9: EXTERNAL LIGHTING AND PILOT LIGHTING

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | | AMOUNT | |
|----------|---|-----|------|-------|------|--------|------|
| | | | | KShs. | Cts. | KShs. | Cts. |
| | Supply, install, test, commission and set to work the following: | | | | | | |
| 9 | Supply, fix into position and test the following light fittings. | | | | | | |
| 9.01 | Lighting points for external lights | 22 | No. | | | | |
| 9.02a) | Type P2 - External light fitting, as per details shown on Drawing No. --E1801-47-- , complete with 36W lamp, as Disano Cat no. 424230-00 or approved equivalent complete with gear, bowl and post top adapter. The fitting to be Wall Bracket and mounted on Perimeter Wall/Column as per details shown. | 8 | No. | | | | |
| b) | As above but mounted on Gate Pillar | 2 | No. | | | | |
| 9.03a) | Type P - External light fitting, as per details shown on Drawing No. -E1801-47--, on a 6m high steel pole, complete with street lamp incorporating 2X18beam LED lamp unit rated 40W as OPTI 40 LED and sourced from Dayliff or any other approved equivalent. The fitting to have Opti SC10LC Lighting control unit, 120W 12V PV Modules monocrystalline, 100Ah 12V Battery sealed type, and 6metres high circular section hollow steel poles, diameter 60mm, 1000mm deep, concrete base and 6mm thick metal base plate and as per details shown. | 10 | No. | | | | |
| 9.03b) | Type R - External Floodlight, as per details shown on Drawing No. ---E1801---, on a 6m high steel pole, complete with 150W LED lamp. The 6metres high circular section hollow steel poles, diameter 60mm, 1000mm deep, concrete base and 6mm thick metal base plate and as per details shown. | 2 | No. | | | | |
| 9.04 | Excavate holes to take the poles, average depth 2000mm, install pole, back-fill with concrete around the pole, back fill soil and compact. | 22 | No. | | | | |
| 9.05 | Earthing for each alternative pole. | 22 | No. | | | | |
| 9.06 | Lucy cutouts in each of the poles complete with 2A HRC fuse. | 8 | No. | | | | |
| 9.07 | 2 core 2.5mm² PVC/SWA/PVC cable to each of the poles for the lights above | 500 | m. | | | | |
| 9.08 | Trenching, removal of earth, sifting of the soil, laying of cable, covering with "HATARI" tiles, backfilling, and compacting to natural ground level. | 500 | m | | | | |
| | Total C/F to next page | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO.9: EXTERNAL LIGHTING AND PILOT LIGHTING

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | | AMOUNT | |
|--|---|-----|------|-------|------|--------|------|
| | | | | KShs. | Cts. | KShs. | Cts. |
| | Total B/F from previous page | | | | | | - |
| 9.09 | 2.5mm ² twin + earth cable between the Lucy cut-out in each of the poles and the lighting fixture. | 500 | m. | | | | |
| 9.1 | 100mm diameter super HG PVC ducts for road/car park crossing. with 100mm concrete surround | 500 | m. | | | | |
| 9.11a) | 8-way TP/N distribution board as Merlin Gerin or Crabtree or any other approved equivalent, complete with 100A TP/N integral isolator and lockable cover including all other accessories. | 1 | No. | | | | |
| b) | 32A SP MCB's in the DB above. | 4 | No. | | | | |
| c) | Blanking plates for un-used spare ways. | 20 | No. | | | | |
| d) | Carry out concise permanent labelling for all the sub-circuits above. | 1 | Item | | | | |
| e) | Earthing for the above board | 1 | Item | | | | |
| f) | 4C 25mm ² PVC/SWA/PVC copper cable from main switchboard to DB "external lighting" | 50 | m | | | | |
| g) | Cable glands for the above cable. | 2 | m. | | | | |
| h) | Cable lugs for the above cable. | 8 | No. | | | | |
| 9.12a) | 32A TPN contactor as Telemecanique for the external lights above. | 4 | No. | | | | |
| b) | 32A TP/N manual by-pass switch across the contactor, complete with mounting box, and indicator lights | 4 | No. | | | | |
| c) | 6A Photoelectric cell unit for automatic control of the lights, as Thorn, complete with protective fuse. | 4 | No. | | | | |
| 9.14 | 38mm H.G. conduit for the above cables. | 50 | m. | | | | |
| 9.15 | Pilot Lighting | | | | | | |
| 9.15a) | Red flashing indicator / aircraft pilot light on top of communication mast and roof of building to approval. | | | | | | |
| | (Please state make/type and enclose catalogue) | 1 | No. | | | | |
| b) | Wiring for item above in 2 core 4.0mm ² PVC/SWA/PVC cable complete with cable ties. | 30 | m. | | | | |
| Total for External Lighting and Pilot Lighting C/F to Collection Page 226 | | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

Bill No 10: PASSENGER LIFT INSTALLATION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|--|--|-----|------|------|--------|------|
| | | | | | KShs | Cts. |
| | Supply, install, test, commission, and set to work the following: | | | | | |
| 10.01 | 150A TP MCCB in Main- Switchboard. | 1 | No | | | |
| 10.02 | Label the above MCCBs thus "LIFT DISTRIBUTION BOARD" in permanent traffolyte labels. | 1 | No. | | | |
| 10.03 | 4-way TP/N distribution board as Crabtree or Merlin Gerlin complete with 100A TP/N integral isolator. | 1 | No | | | |
| 10.04 | 4C 25mm ² PVC/SWA/PVC copper cable to the lift distribution board in lift motor room. | 30 | m. | | | |
| 10.05 | Cable glands for the cable above. | 2 | No. | | | |
| 10.06 | Cable lugs for the cable above complete with hydraulic crimping | 8 | No. | | | |
| 10.07 | 63A TP MCB in the above board. | 3 | No. | | | |
| 10.08 | Blanking plates for un-used spares | 1 | No. | | | |
| 10.09 | Labelling of all the final sub-circuits in item above in permanent traffolyte labels. | 3 | Item | | | |
| 10.1 | 63A TPN local isolator in lift motor room | 3 | No. | | | |
| 10.11 | 5C 25mm ² flexible PVC-PVC- copper cable between isolators above and lift motor | 15 | m. | | | |
| 10.12 | Lighting points in the lifts shaft in 20mm Class B galvanized steel conduit, steel box, wiring in 3 x 1.5 mm ² SC-PVC-CU cables metal-clad 5A 1-gang switch and all accessories. | 3 | No. | | | |
| 10.13 | Outlet for 13A metal-clad twin socket outlet complete with 20mm class B galvanized steel conduits, twin steel box and all accessories including 13A twin Metal-clad socket at 1400mm affl. | 3 | No. | | | |
| 10.14 | Outlet for extract fan in the lift shaft, comprising box, concealed PVC conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A DP switch with neon light. | 3 | No. | | | |
| 10.15 | 38mm H.G. conduit for the above cables. | 60 | m. | | | |
| Total for Lift Installations C/F to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 11: LIGHTNING PROTECTION

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Note: All lightning protection products to be FURSE – Alternative makes will NOT be accepted. | | | | | |
| 11 | Air Termination | | | | | |
| 11.01 | 15mm diameter multiple point copper air terminal as Furse Cat. No. RA 600. | 10 | No. | | | |
| 11.02 | Copper air terminal base as Furse Cat. No. SD 105. | 10 | No. | | | |
| 11.03 | Copper junction clamps for tape. | 40 | No. | | | |
| 11.04 | 25 x 3mm turned copper tape as Furse Cat. No. TC 230. | 100 | m. | | | |
| 11.05 | Copper ridge saddle as Furse Cat. No. CD 115. | 30 | No | | | |
| 11.06 | D.C. tape clip as Furse Cat. No. CP 210. | 30 | No | | | |
| 11.07 | Copper rod-to-tape coupling. | 10 | No. | | | |
| 11.1 | Down Conductors | | | | | |
| 11.11 | 25 x 3mm turned copper tape as Furse Cat. No. TC 230. | 60 | m. | | | |
| 11.12 | D.C. tape clip as Furse Cat. No. CP 210. | 20 | No | | | |
| 11.13 | Oblong test/junction clamp as Furse Cat. No. CN 105. | 10 | No. | | | |
| 11.14 | Diameter 38mm HG PVC conduits for the down conductors above. | 60 | m. | | | |
| 11.2 | Earth Termination | | | | | |
| 11.21 | 15mm diameter, 1200mm long solid copper earth rod as Furse Cat. No. RC 020, complete with driving stud and spike. | 2 | No. | | | - |
| 11.22 | Earth rod-to-tape clamp type A. | 2 | No. | | | - |
| 11.23 | Concrete inspection earth pit Cat. No. PT 005 with 5 hole earth bar as Furse Cat. No. PT 006. | 2 | No. | | | - |
| 11.24 | 1500mm x 1500mm copper earth mat made from 25mm x 3mm copper tape at 300mm spacing, buried at permanent moisture level and complete with all clamps, welding joints and 6m long 25mm x 3mm insulated copper tape clamped to the down conductors. | 2 | No. | | | - |
| 11.3 | Bonding | | | | | |
| 11.31 | Bonding and clamping to all metal work including water pipes, gas pipes, hand-rails, air-conditioning units, window frames, cladding, metal roof etc. and the main earth for the building. | 1 | Item | | | - |
| Total for Bill No.11 –Lightning Protection C/F to Summary Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL No. 12: INSTALLATION OF MECHANICAL PUMPS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT KShs. Cts. |
|--|--|-----|------|------|----------------------|
| | Supply, install, test and commission the following:- | | | | |
| 12.00a) | 100A TP MCCB in the main switch board for Pumps | 1 | No. | | |
| 12.01a) | 6-way TP/N power distribution board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Crabtree or Multi-9, or approved equivalent and Located in the Pump House. | 1 | no. | | |
| b) | 32A TP MCB in the boards above. | 3 | No. | | |
| c) | 32A SP MCB in the boards above. | 1 | No. | | |
| d) | 40A TP MCB in the boards above. | 0 | No. | | |
| e) | Label the above MCB's as per the details of the pump served. | 1 | Item | | |
| f) | Install blanking plates for un-used spare ways | 8 | No. | | |
| g) | 4-core 25mm ² PVC/SWA/PVC cables for the above boards complete with cable glands and cable lugs | 30 | m. | | |
| 12.02 | Label the above MCCBs thus: "SUPPLY TO DOMESTIC PUMPS and SPRINKLER/HOSE REEL PUMPS: DO NOT SWITCH OFF" in red 10mm higher permanent traffolyte labels. | 4 | Item | | |
| 12.03 | Outlet for water booster pumps/borehole/sprinkler, comprising box, concealed PVC conduit, wiring in 3 x 6.0 mm ² SC-PVC-CU cables and all accessories including 32A TPN Isolators at Pump House | 3 | No. | | |
| 12.04 | Sub mains circuit comprising 4C 6.0mm ² PVC/SWA/PVC copper cable from the MCCB to the local isolators for water booster/borehole/sprinkler pumps, fire pumps complete with cable glands and cable lugs | 50 | m. | | |
| 12.05 | Outlet for hose reel pump comprising box, concealed PVC conduit, wiring in 3 x 4.0 mm ² SC-PVC-CU cables and all accessories including 20A SPN Isolators in each block | 1 | No. | | |
| 12.06 | Sub mains circuit comprising 2C 4.0mm ² PVC/SWA/PVC copper cable from the MCCB to the local isolators for hose reel pumps, complete with cable glands and cable lugs | 50 | m. | | |
| Total for Bill No. 12: Installation of Pumps C/F to Collection Page 226 | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 13: FIRE DETECTION AND ALARM INSTALLATIONS

| Item No. | Description | Qty | Unit | Rate | Amount | |
|----------|---|-----|------|------|--------|------|
| | | | | | KSh. | Cts. |
| | Supply, install, test, commission and set to work the following:- All fire alarm equipment to be as per relevant KS and BS standards. This fire alarm specification is for a fully addressable analogue system. Supplying a conventional system will lead to automatic disqualification. And due to the sensitivity of this contract, only the specified items to be supplied. Alternatives, will NOT be accepted. | | | | | |
| 13.00 | Outlet for fire alarm points wired in 3 x 1.5mm ² screened fire-proof cable as FIREPIX or approved equivalent, and all accessories | 350 | No. | | | - |
| 13.01 | Outlet for fire alarm panels/repeater panels comprising 2A fused unswitched spur outlet, concealed PVC conduit, wiring in 3 x 2.5mm ² SC-PVC-CU cables. | 2 | No. | | | - |
| 13.02 | Analogue photoelectric smoke detector complete with lockable base and alarm indicator LED. (State make and type). | 269 | No. | | | - |
| 13.03 | Analogue addressable heat detector complete with lockable base and alarm indicator LED. (State make and type) | 20 | No. | | | - |
| 1.04a) | Addressable manual call points complete with monitoring resistor, protective plastic coating on the glass, test key and polycarbonate flap. (State make and type) | 35 | No. | | | - |
| 13.04b) | Addressable weatherproof manual call points complete with monitoring resistor, protective plastic coating on the glass, test key and polycarbonate flap. (State make and type) | 5 | No | | | - |
| 13.05a) | Addressable electronic loop sounder wired direct onto the detection loop and powered from the loop, suitable for both external and internal application complete with volume control, a choice of 12 different sounds and rated at 85-100 dBA at 1 m. (State make and type). (State make and type). | 18 | No. | | | - |
| 13.05b) | High efficiency xenon beacons with enhanced optical design for maximum light dissipation and 2W xenon discharge lamp rated IP65. (State make and type). | 5 | No. | | | - |
| 13.06 | Addressable standard interface units (using relays) for connecting detectors in voids , and to serve as remote indicators when detector triggers in the void. (State make and type). | 10 | No. | | | - |
| | Total C/F to next page | | | | | |
| | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - FIRE ALARM INSTALLATIONS

BILL NO. 13: FIRE DETECTION AND ALARM INSTALLATIONS

| Item No. | Description | Qty | Unit | Rate | Amount | |
|--|--|-------|------|------|--------|------|
| | | | | | KSh. | Cts. |
| | Total B/F from previous page | | | | | - |
| 13.07 | Short circuit isolator for protecting a fire detection loop by making sure a short-circuit or an open circuit fault in any zone does not affect other zones. (State make and type). | 10 | No. | | | - |
| 13.08 | 2-loop Analogue addressable fire detection and alarm control panel complete with printer, 8 lines 80 character LCD. The control panel to be designed to meet fully the requirements of EN54 Pt. 2 and 4: 1998 and BS 5839 Part 1. The panel to be complete with battery pack and automatic charger for minimum 72-hour operation under conditions of sustained power failure. (State make and type). The main panel to be located in the Main Security office | 1 | No. | | | - |
| 13.09 | Analogue addressable repeater panel, wired to the main panel above, and complete with a 72-hour battery pack and automatic charger, to work in conjunction with the main panel. (State make and type). The repeater panel to be located in Guard House at the gate. | 1 | No. | | | - |
| 1.10a) | Fire Alarm Graphics software complete with a desk top computer and capable of full control of fire alarm system as designed by FIREPIX, or other approved software vendors. | 1 | No. | | | - |
| 13.10b) | Communications Drive Unit | 1 | No. | | | - |
| 13.10c) | Serial Communications Interface Unit | 1 | No. | | | - |
| 13.11 | Allow for linking the above main fire alarm panel as dedicated zone on the security alarm panel. | Item | | | | - |
| 13.12 | Carry out wiring in 3 x 1.5mm ² in FIRE-RESISTANT, SCREENED cable, all drawn inside the above ducts/conduits. [Note: The cable must be FIRE-RESISTANT and not merely heat resistant. This has to be demonstrated at presentation of sample] | 6,000 | m. | | | - |
| Total for Bill No. 13: Fire Detection and Alarm Installations - C/F to Summary page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 14 – SUPPLY / INSTALLATION OF UPS EQUIPMENT

| Item No. | Description | Qty | Unit | Rate | Amount KShs. Cts. |
|--|---|-----|-------|------|----------------------|
| | Supply, install, test, commission and set to work (to the full satisfaction of the Client, including initial training) the following: | | | | |
| 14.00 | 100 KVA/KW true-on-line, uninterruptible power supply (UPS unit), with a 30-minute autonomy, both internal bypass and external manual bypass, external 5000:1 voltage surge/spike protection, and all the other details as per technical specifications, including the options. | 1 | No. | | |
| 14.02 | Allow for 10% of Item No. 1.00 above to cover for currency fluctuation | 1 | Item | | |
| 14.03 | Allow for detailed training, demonstrations, full-load testing, providing technical manuals, users hand-book etc. | | Item | | |
| 14.04 | Liaison with Electrical sub-contractor to ensure proper cabling, phase-sequencing, and terminations are done. | | Item | | |
| 14.05 | Allow for preparation and presentation of detailed working drawings (and as-installed drawings on completion) both in hard and soft copies. | | Item | | |
| 14.06a) | 4C 50mm ² PVC/SWA/PVC copper cables | 10 | m. | | |
| b) | Cable glands for the above cable | 4 | No. | | |
| c) | Cable lugs for the above cable, complete with hydraulic crimping | 16 | No. | | |
| 14.07 | Allow for the following comprehensive performance testing of the UPS units to the entire satisfaction of the client and all parties to the contract:- i. Full load testing of THE UPS units with 100% (1.00 p. f.) resistive load. ii). Perform CONTINUOUS 100% loading of the UPS units while on resistive load iii). Perform alternate on/off switching of each unit to demonstrate the second unit takes the load without time elapse. v). Provide cabling, connections, all accessories, instruments, tools and all the required items for above testing on the 'dry' resistive load | | Items | | |
| Total for Bill No. 14 C/F to Summary Page 226 | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES -ELECTRICAL INSTALLATIONS

BILL NO. 15 – SUPPLY / INSTALLATION OF SOLAR PV LIGHTING FOR COMMON AREAS

| Item No. | Description | Qty | Unit | Rate | Amount | |
|----------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Supply, install, test, commission and set to work (to the full satisfaction of the Client, including initial training) the following: (Prices to be inclusive of VAT and in KSh.) Kindly state make and country of origin of each equipment | | | | | |
| 15.00 | Solar PV System | | | | | |
| 15.01 | Solar PV Modules as Monocrystalline Al. Grade A 24V 275W. The PV Modules to be connected in series/parallel as necessary with 1No. PV module in each string. Total no of strings to be 91No. The Panels to be manufactured by Jinko Solar or Canadian Solar or any other approved equivalent. Please state make and country of origin. The panels to have warranty of over 20years | 91 | No. | | | - |
| 15.02 | 2 X 35mm ² copper cables RED/BLACK from PV modules to charge controller. Note that each of the charge controllers is supplied separately by a group of 7No. Solar PV Modules in Parallel. | 200 | m. | | | - |
| 15.02a) | Cable glands for the above cable | 14 | No | | | - |
| 15.02b) | Cable lugs for the above cable complete with hydraulic crimping | 28 | No | | | - |
| 15.03 | 2X 70mm ² flexible copper cables RED/BLACK from charge controller to batteries and from batteries to Inverter | 100 | m. | | | - |
| 15.03a) | Cable glands for the above cable | 14 | No | | | - |
| 15.03b) | Cable lugs for the above cable complete with hydraulic crimping | 28 | No | | | - |
| 15.04 | 2X35mm ² copper cables RED/BLACK from inverter to Main Solar Power Consumer Unit | 20 | m. | | | - |
| 15.04a) | Cable glands for the above cable | 2 | No | | | - |
| 15.04b) | Cable lugs for the above cable complete with hydraulic crimping | 6 | No | | | - |
| | Total C/F to next page | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 15 – SUPPLY / INSTALLATION OF SOLAR PV LIGHTING FOR COMMON AREAS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|----------|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| 15.05 | 80Amps MPPT Charge controller at 24V. The charge controllers to be supplied in 12No. Groups by 7No. PV Modules each and to be Manufactured by Outback Power or as Victron Quattro or any other approved equivalent. State make and country of origin. With ten years warranty. To come with inbuilt LVD switch. | 12 | No. | | | |
| 15.06 | Minimum 2V 1500Ah MF GEL Solar Batteries or approved equivalent with over 20years life. Days of autonomy is 1.5. Equivalents to be approved by the engineer. The Batteries to be Sealed Type European/USA made deep-cycling and maintenance free. With over five years warranty. | 60 | No. | | | |
| 15.07a) | 15KW Grid-tie Solar Inverter at 24V/240V, 50Hz as Outback Power / Victron Power or equivalent. State make and country of origin. To come with inbuilt LVD switch. | 1 | No. | | | |
| b) | Solar PV Home manager that gives priority to solar energy | 1 | No. | | | |
| c) | Communication equipment | 1 | lot | | | |
| 15.08 | Allow for the rack to mount on the batteries and inverter. This to be fabricated to allow stacking of solar batteries. To be powder coated and with a lockable door. | 1 | item | | | |
| 15.09 | Provision for 80A SPN rated by-pass switch across the inverter for Mains Power Supply | 1 | No. | | | |
| 15.1 | 15 incoming and 15 outgoing DC busbar rated 630Amps with DC breakers 100Amps each to manage the charge controllers and solar batteries. Please present a wiring diagram before fabrication. | 1 | No | | | |
| 15.11 | 8-way SP/N power consumer unit for solar power complete with 80A SP/N integral isolator and all accessories including lockable cover. The CU to be as Merlin Gerlin or approved equivalent. | 7 | No | | | |
| a) | 3C 25mm ² PVC/SWA/PVC copper cable | 300 | m. | | | |
| b) | Cable glands for the above cable | 14 | No. | | | |
| c) | Cable lugs for the above complete with hydraulic crimping | 56 | No. | | | |
| | Total C/F to next page | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 15 – SUPPLY / INSTALLATION OF SOLAR PV LIGHTING FOR COMMON AREAS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|---|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | - |
| | d) SP MCB in the above boards | 28 | No. | | | - |
| | e) Blanking plates for un-used spare ways. | 28 | No. | | | - |
| | f) Earthing for the boards above. | 1 | Lot | | | - |
| | | | | | | - |
| 15.12 | Allow for detailed training, demonstrations, full-load testing, providing technical manuals, users hand-book etc. | 1 | Item | | | - |
| | | | | | | - |
| 15.13 | Allow for preparation and presentation of detailed working drawings (and as-installed drawings on completion) both in hard and soft copies. | 1 | Item | | | - |
| | | | | | | - |
| 15.14 | Any other accessories/tools to finish the installation. List - ----- ----- | 1 | lot | | | - |
| | | | | | | - |
| 15.15 | Give five years warranty on installed equipment. | 1 | item | | | - |
| | | | | | | - |
| | | | | | | - |
| 15.16 | Comprehensive earthing for the above | 1 | item | | | - |
| | | | | | | - |
| 15.17 | Mounting steel structure for the solar panels on the roof. The support structure, mountings and fixing bolts/nuts to be weather proof and corrosion resistant. Please visit site before quoting. | 1 | Lot | | | - |
| | | | | | | - |
| 15.18 | Lightning surge protection and earthing for the installation. | 1 | Item | | | - |
| | | | | | | - |
| 15.19 | Installation of CAUTION signs for the entire installation | 1 | Item | | | - |
| | | | | | | - |
| 15.20 | Smart Energy meter in between the solar grid inverter and the building distribution board to measure gross solar AC energy production | 1 | No. | | | - |
| | | | | | | - |
| 15.21 | Documentation including; i. System description with working principles, ii. System single line diagram, iii. Solar PV array lay-out., iv. Routing diagram of cables and wires, v. Data sheets and user manuals of the solar PV panels and the solar grid inverter, vii. Name, address, mobile number and email address of the service centre to be contacted in case of failure or complaint, ix. Maintenance register, viii. Warranty cards. | 1 | Item | | | - |
| | | | | | | - |
| 15.22 | Attendance by the Electrical sub-contractor | 1 | Item | | | - |
| 15.23 | 450x150mm Cable tray | 50 | Item | | | - |
| 15.24 | Battery monitor as Victron BMV-702 or equivalent | 1 | No. | | | - |
| 15.25 | PV disconnect switch | 1 | No. | | | - |
| | | | | | | - |
| Total for Bill No. 15 Installation of Solar PV System to Collection Page 226 | | | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILL NO. 16– GENERAL ITEMS

| Item No. | Description | Qty | Unit | Rate | Amount KSh. Cts. |
|-------------------------------|--|-----|------|------|---------------------|
| 16.00a) | Supply, install, test, commission and set to work the following: Carry out comprehensive 48-hour power analysis, after installing main switchboard, UPS, AVR, but before switching on load, upgrading of switch-gear, with a digital power meter (with printer) to: S) Record and print all the power system parameters. ii) Submit 3 copies of the print-outs. (Note: Parameters must be satisfactory before building is switched on). | | Item | | |
| b) | Carry out comprehensive Fire Detection and Alarm System installations testing and analysing, after installations. Prior to testing and commissioning conduct comprehensive programming of the system by approved manufacturer's representative to perform as instructed by the Engineer, including ringing patterns. | | | | |
| 16.01 | Allow for sub-contractors charges for liaison with Kenya Power and Lighting comprising the following:- i) Extracting load details from the drawings ii) Calculating total load, together with necessary diversity iii) Verifying the details with the engineer. iv) Getting the required documentation and letters from client v) Filling all the required forms, and generating correspondences for power application. vi) Presenting application and getting reference number. vii) Making regular follow-ups with KPLC viii) Facilitating inspection, approvals and certification by KPLC ix) Providing attendance and materials required for power connection. x) Filling out and submitting Commencement and Completion certificates xi) Handing over all approved drawings and certificates to the client. xii) Performing all other services required for power supply to site. xiii) Building/modifying all power manholes to KPLC standards. xiv) All other incidental KPLC requirements/charges. | | Item | | |
| 16.02 | Carry out comprehensive 48-hour power analysis, after switching main switchboard on full load but AVR off, with a digital power meter (with printer) to: S) Record and print all the power system parameters. ii) Submit 3 copies of the print-outs. | | Item | | |
| 16.03 | With the AVR "on" repeat the above process but before the AVR (i.e. on the supply side of the AVR) | | Item | | |
| Total C/F to next page | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 16- GENERAL ITEMS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|-------------------------------|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | |
| 16.04 | With the AVR “on” repeat the above process but after the AVR (i.e. on the load side of the AVR) | | Item | | | |
| 16.05 | Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings. | | Item | | | |
| 16.06 | Prepare and submit Working Drawings as follows:- i) Draft soft copy in Archicad® and Autocad® 2000 in CD-RW. ii) Amended soft copy in Archicad® and Autocad® 2000 in CD-RW. iii) 5 Final soft copies in Archicad® and Autocad® 2000 in CD-RW to Architect, Client, Quantity Surveyor, and Engineer (2 copies) iv) 3 Draft hard-copies of Working Drawings in Ao (Scales 1:50, 1:25) to Engineer, Architect and Main Contractor. v) 2 Amended hard copies of Working Drawings in Ao (Scales 1:50 and 1:25) to Engineer, Architect and Main Contractor. vi) 11 No. Final hard copies of working drawings in Ao (Scales 1:50, 1:25) to Engineer (3 copies), Architect (1 copy), Quantity Surveyor (1 copy), Client (3 copies), Contractor (3 copies). (Note: Full set of drawings to be presented as per drawing list). | | Item | | | |
| 16.07 | As item no. 16.06, but for Record (As-Installed) Drawings comprising: i) Fully dimensioned drawings of all plants and apparatus. ii) General arrangement drawings of equipment, plant etc. iii) Routes – types and sizes and arrangement of all pipework. iv) System schematics and trunking diagrams showing all salient information relating to control and instrumentation. v) Grading charts vi) Wiring and piping diagrams of plant and apparatus. vii) Schematic diagram of individual plants and switch viii) All the required operating instructions for all panels, boards, control panels etc. | | Item | | | |
| Total C/F to next page | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

BILLS OF QUANTITIES - ELECTRICAL INSTALLATIONS

BILL NO. 16- GENERAL ITEMS

| ITEM NO. | DESCRIPTION | QTY | UNIT | RATE | AMOUNT | |
|---|--|-----|------|------|--------|------|
| | | | | | KShs. | Cts. |
| | Total B/F from previous page | | | | | |
| 16.08 | Prepare and submit Maintenance Manuals for all items installed. | | Item | | | |
| 16.09 | Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months. | | Item | | | |
| 16.10 | Allow for removal of any existing power services on site, comprising:- i) Applying to the Kenya Power and Lighting Co. to disconnect and remove such services, including any power meters that may be on site. ii) Making all the required liaison with KPLC to ensure speedy disconnection, removal, and/or re-routing of all services that may be existing on site. (Note: The tenderer <u>MUST</u> visit site to assess and establish the nature of all existing services on site). | | Item | | | |
| 16.11 | Allow for removal of any existing communications services on site, comprising:- i) Applying to the Telkom Kenya Ltd. to disconnect and remove such services that may be on site. ii) Making all the required liaison with Telkom Kenya Ltd. to ensure speedy disconnection, removal, and/or re-routing of all services that may be existing on site. (Note: The tenderer <u>MUST</u> visit site to assess and establish the nature of all existing services on site). | | Item | | | |
| Total for Bill No. 16 - General Items C/F to Collection Page for Electrical Installations Page 226 | | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY
ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES- BILLS OF QUANTITIES

PRICE SUMMARY PAGE FOR ELECTRICAL INSTALLATIONS

| ITEM | DESCRIPTION | AMOUNT KSHS. CTS. |
|---|---|----------------------|
| 1 | Bill No. 1: Mains Power Supply and Distribution B/F | - |
| 2 | Bill No. 2: Basement Floor Lighting & Power B/F | - |
| 3 | Bill No. 3: Ground Floor Lighting & Power B/F | - |
| 4 | Bill No. 4 : First Floor Lighting & Power B/F | - |
| 5 | Bill no. 5 Second Floor Lighting & Power B/F | - |
| 6 | Bill No. 6:Third Floor Lighting & Power B/F | - |
| 7 | Bill No. 7 : Fourth Floor Lighting & Power B/F | - |
| 8 | Bill No.8 Supply to AC Equipment B/F | - |
| 9 | Bill No. 9 External Lighting B/F | - |
| 10 | Bill No. 10: Installation of Passenger Lifts B/F | - |
| 11 | Bill No. 11 Lightning Protection B/F | - |
| 12 | Bill No. 12: Installation of Mechanical Pumps B/F | - |
| 13 | Bill No. 13: Fire Alarm and Detection B/F | - |
| 14 | Bill No. 14: UPS Equipment B/F | - |
| 15 | Bill No. 15: Solar PV Installations B/F | - |
| 16 | Bill No. 16 General Items B/F | - |
| 17 | Sub-Contract Preliminaries, B/F from Section 4 | - |
| 18 | Allow for sub-contractors charges for liaison with Kenya Power and Lighting during the works comprising the following: - i) Getting the required documentation and letters from client ii) Filling all the required forms, and generating correspondences iii)Presenting application and getting reference number iv) Making regular follow-ups with KPLC v) Facilitating inspection, approvals and certification by KPLC vi) Providing attendance and materials required for power connection. vii) Filling out and submitting Commencement and Completion certificates viii) Handing over all approved drawings and ix) Performing all other services required for power re connection to the building. x) Building/modifying all power manholes to KPLC standards xi) All other incidental KPLC requirements/charges. | - |
| 19 | Allow for careful removal of existing electrical services on site and handing over to the client/landlord | - |
| 20 | Sub-Total | - |
| 21 | Allow for 5% contingency and variation of price (VOP) | |
| 22 | Provision for Kenya Power and Lighting Company charges | 2,500,000.00 |
| Total for Electrical Installations Carried Forward to Summary page 232 | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET

BILLS OF QUANTITIES

BILL NO. 1: STANDBY GENERATORS AND ASSOCIATED WORKS

| Item No. | Description | Qty | Unit | Rate | Amount KSh. |
|-------------------------------|---|-----|------|------|----------------|
| 1.0 | Supply of 2 No.200KVA sound-proofed and synchronised standby generating set, with Deep Sea Controllers as Cummins, Perkins or Caterpillar, equivalent to be approved, with Stamford, Leroy Somer, Perkins, Cummins, Caterpillar engine/alternator, 415V/240V 3-phase, 1500 rpm, Max 80 dBA at 1 M. (*Site rating, to be achieved in Bondo which is at 1266m asl. Supplier to state actual sea-level rating as per appendices 1 and 2). | 2 | No. | | |
| 2.0 | An intelligent Synchronising Deep Sea Controller or equivalent and to be approved for the 2No. 200KVA generator sets with remote audible alarm for failure and busbar arrangement. The controller should be complete with the following and to be approved Generator selector controls wired such that the generators will come 'ON' in sequential order , if one fails then the other comes on automatically. Should also have an auto and semi auto selection switch and gen1/gen2 direct selection switch . If the load is less than 200KVA, then one Gen Set should come on, else all two sets come on at the same time. If the load is less than 200KVA but constant for more than 6hours, then the two sets operate alternately. The panel to be complete with all breakers and accessories and to be approved. Please present a wiring diagram for approval before fabrication. | 1 | no | | - |
| 3.0 | Installation of 2No Generating sets including the Synchronization | 1 | item | | - |
| 4.0 | Supply of daily service tanks | 2 | No. | | - |
| 5.0 | Installation of daily service tanks | 2 | No. | | - |
| 6.0 | Supply of control panel(s), (complete with ov/uv relays) | 2 | No. | | - |
| 7.0 | Installation of control panel(s) | 2 | No. | | - |
| 8.0 | Supply of Automatic changeover contactor unit(s) | 2 | No. | | - |
| 9.0 | Installation for Automatic changeover contactor unit(s) | 2 | No. | | - |
| 10.0 | Comprehensive and detailed testing/Commissioning of the set as per full procedures set out in the Technical Specifications | 1 | item | | - |
| Total C/F to next page | | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET
BILLS OF QUANTITIES

BILL NO. 1: STANDBY GENERATOR AND ASSOCIATED WORKS

| Item No. | Description | Qty | Unit | Rate | Amount KSh. |
|----------|--|-----|------|------|----------------|
| | Total B/F from Previous Page | | | | - |
| 11.0 | Supply of. fuel transfer pumps plus the necessary piping to interconnect the daily service tank and the fuel storage tank | 2 | No. | | |
| 12.0 | Installation of the fuel transfer pump and all pipework | 2 | no | | |
| 13.0 | Supply and installation of a fuel | 2 | no. | | |
| 14.0 | Cost of tools as per Appendix No. 4 | 2 | Item | | |
| 15.0 | Cost of spares as per Appendix No. 5 | 2 | Item | | |
| 16.0 | Cost of earthing as per Appendix No. 6 | 2 | Item | | |
| 17.0 | Industrial silencer for the generator sets | 2 | No. | | |
| 18.0 | Dia. 100mm, 3mm thick galvanized stainless steel tube exhaust system for generator complete with brackets and black industrial (gloss paint) | 5 | LM | | |
| 19.0 | Hot air ducting as per details shown in Appendix 12 | 2 | Item | | |
| 20.0 | 5000 lts (5 m3) external fuel tank, as per details shown in Appendix No. 11 and to be complete with 1000litres of fuel | 1 | Item | | |
| 21.0 | Allow for performing 100% full load testing of the generator above with 100% resistive load. Contractor to allow for all the necessary cabling and communications. Photograph of the resistor bank to be enclosed with the load. | 2 | Item | | |
| 22.0 | Introduce external anti-vibration dumpers to supplement the factory-made ones | 2 | No. | | |
| 23.0 | Any other items (to be detailed) | | Item | | |
| 24a) | 2X 4core 185mm2 PVC/SWA/PVC (Please Note: The two cables to be run in parallel, and unit rate above to be 2 x Unit rate for 1 No. 4core 185mm2 PVC/SWA/PVC CU cable | 40 | m | | |
| 24b) | Cable glands for the above cable | 4 | No. | | |
| 24c) | Cable lugs for the above cable, Complete with hydraulic crimping | 16 | no. | | |
| | Total C/F to next page | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET
BILLS OF QUANTITIES

BILL NO. 1: STANDBY GENERATOR AND ASSOCIATED WORKS

| Item No. | Description | Qty | Unit | Rate | Amount KSh. |
|----------|---|-----|------|------|----------------|
| | Total B/F from Previous Page | | | | - |
| 26a) | 3C 4mm ² PVC/SWA/PVC copper control cable | 40 | LM | | |
| 26b) | Cable glands for the above cable | 2 | No. | | |
| 26c) | Cable lugs for the above cable | 8 | no. | | |
| 27.0 | 4.5 Kg carbon dioxide gas fire extinguisher complete with Pressure Gauge, initial charge and mounting brackets. | 2 | no | | |
| 28.0 | 9 kg dry powder fire extinguisher complete with initial charge and mounting brackets | 1 | no | | |
| 29 | <p>The following <u>mandatory</u> tests to be performed on the <u>2 No.</u> generator sets to the full satisfaction of the Client and all the parties to the contract:-</p> <ul style="list-style-type: none"> i. Off-load tests for EACH set ii. Full-load tests for EACH set with resistive loads, up to 110% loading iii. Complete testing and demonstration of the Synchronizing panel iv. Demonstration of the performance and function of the Synchronizing panel including alternative simulation of plant failure, alternative duty performance of each set as pre set change-over times taken for the “standby” set to kick in upon the capacity of “duty” set being exceeded, v. Detailed log-ins of alternative performance of the two sets over a 24-hour period of non-stop running at full load. <p>The supplier must demonstrate ability of the sets to run alternately at the preset set change-over times over the 24 hour period</p> <ul style="list-style-type: none"> vi. Provision of all the required instrument, tools and fuel required to undertake a 24-hour full-load performance testing of BOTH sets while on load vii. All the required cabling and terminations between the <p style="padding-left: 40px;">Generators, Synchronizing Panel and the dry-loads.</p> <p style="padding-left: 40px;">The cables to be the same sizes/numbers as measured elsewhere in this document</p> | | | | |
| 31 | Sub-Total for 2 Sets of Generators C/F to Summary Page | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET

BILLS OF QUANTITIES

BILL NO. 2 – GENERAL ITEMS

Note: This section MUST be priced, otherwise 5% of the tender figure will be taken to be cost of General Items

| Item No. | Description | Qty | Unit | Rate | Amount KSh. |
|----------|---|-----|------|------|--|
| 2.00 | Carry out comprehensive 24-hour power analysis, after installation of the Generator sets, with a digital power meter (with printer) to: i) Record and print all the power system parameters. ii) Submit 3 copies of the print-outs. (Note: Parameters must be satisfactory before power is switched on). | 1 | Item | | |
| 2.01 | Acquire and submit a Bank Guarantee for 10% of the sub-contract sum, as a Performance Guarantee. | 1 | Item | | |
| 2.02 | Acquire and submit Insurance for the sub-contract work. | 1 | Item | | |
| 2.03 | Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings. | 1 | Item | | |
| 2.04 | Prepare and submit Working Drawings as follows:- i) Draft soft copy in Archicad® and Autocad® in CD-RW. ii) Amended soft copy in Archicad® and Autocad® in CD-RW. iii) 5 Final soft copies in Archicad® and Autocad® in CD-RW to Client and Engineer (2 copies) iv) 3 Draft hard-copies of Working Drawings in Ao (Scales 1:50, 1:25) to Engineer and Client . v) 2 Amended hard copies of Working Drawings in Ao (Scales 1:50 and 1:25) to Engineer and Client. vi) 11 No. Final hard copies of working drawings in Ao (Scales 1:50, 1:25) to Engineer (7 copies) and Client (4 copies). (Note: Full set of drawings to be presented as per drawing list). | 1 | Item | | - - - - - - - - - - |
| 2.05 | As item no. 2.04, but for Record (As-Installed) Drawings comprising: i) Fully dimensioned drawings of all plants and apparatus. | 1 | Item | | - - - |
| | Total C/F to next page | | | | - |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET
BILLS OF QUANTITIES

BILL NO. 2 – GENERAL ITEMS

| Item No. | Description | Qty | Unit | Rate | Amount KShs |
|----------|--|-----|------|------|----------------|
| | Total B/F from Previous Page | | | | - |
| | <ul style="list-style-type: none"> ii) General arrangement drawings of equipment, plant etc. iii) Routes – types and sizes and arrangement of all pipework. iv) System schematics and trunking diagrams showing all salient information relating to control and instrumentation. v) Grading charts vi) Wiring and piping diagrams of plant and apparatus. vii) Schematic diagram of individual plants and switch and control boards. viii) All the required operating instructions for all panels, boards, control panels etc. | | | | |
| 2.06 | Prepare and submit Maintenance Manuals for all items installed. | | Item | | |
| 2.07 | Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months. | | Item | | |
| 2.08 | <u>All other items</u> of general preliminary to cover, but not limited to:- <ul style="list-style-type: none"> i) Attendance on all other sub-contractors, such as for Communication Services, Mechanical Installations, Security Installations, Sound Equipment/ Wiring Installations, Generator Installations, Lift Services, Solar Water Heating, V-Sat services etc. ii) Hiring and keeping a Supervisor/Foreman on site iii) Constant supervision of the works. iv) Provision of all the required spares. v) Testing and Inspection of materials/works. vi) Provision of labour camps. vii) Storage of materials. viii) Initial maintenance (During Defects Liability) ix) Providing water/electricity for the works. x) Protection of the works/materials xi) Clearing away on completion. xii) Preparing Final Account. xiii) Providing all Test Certificates, etc. | | Item | | |
| | Total Carried Forward to Summary Page | | | | |

PROPOSED ADMINISTRATION BLOCK FOR JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUPPLY AND INSTALLATION OF 2No. 200 KVA SOUND-PROOFED STANDBY GENERATOR SET
BILLS OF QUANTITIES

SUMMARY PAGE

| Item No. | Description | Amount | |
|----------|--|--------|------|
| | | KSh. | Cts. |
| S.1 | Bill No. 1 Standby Generator Installations B/F | | - |
| S.2 | Bill No. 2 General Items B/f | | - |
| S.3 | Bill No. 3: Sub-contract Preliminaries B/F from Part D | | - |
| S.4 | Sub-Total | | - |
| S.5 | Add 5% of the Sub-Total in Item No. S.4 above as Contingency | | - |
| S.6 | Warranty: The warranty period for all equipment shall be _____ months from the date of commissioning (Minimum: 12 calendar months) | | |
| S.7 | Total for Generator Installations | | - |
| S.8 | Total for Electrical Installations B/F from page 226 | | |
| S.9 | Total for Electrical/Generator Installation Works C/F to Form of Tender | | |

Total Amount in words

.....

Tenderer's Name and Stamp

Signature.....

Date

PIN No.

VAT No.

Witness Address

Signature

Date

SECTION VIII

STANDARD FORMS

- (i) Form of Invitation for Tenders
- (ii) Form of Tender
- (iii) Appendix to Form of Tender
- (iv) Letter of Acceptance
- (v) Form of Agreement
- (vi) Form of Tender Security
- (vii) Performance Bank Guarantee (unconditional)
- (viii) Bank Guarantee for Advance Payment
- (ix) Tender Questionnaire
- (xi) Confidential Business Questionnaire
- (x) Statement of Foreign Currency Requirement
- (xi) Schedule of Materials;- Basic Prices
- (xii) Schedule of Labour;- Basic Prices
- (xiii) Schedule of Plant and Equipment
- (xv) Details of Sub-Contractors
- (xvi) Certificate of Tenderer's Site visit
- (xvii) Form of Written Power of Attorney
- (xviii) Key Personnel
- (xix) Completed Civil Works
- (xx) Schedule of Ongoing Projects
- (xxi) Other Supplementary Information
- (xxii) Request for Review Form

FORM OF INVITATION FOR TENDERS

_____ [date]

To: _____ [name of Contractor]
_____ [address]

Dear Sirs:

Reference: _____ **[Contract Name]**

You have been prequalified to tender for the above project.

We hereby invite you and other prequalified tenderers to submit a tender for the execution and completion of the above Contract.

A complete set of tender documents may be purchased by you from
_____ [mailing address, cable/telex/facsimile numbers].

Upon payment of a non-refundable fee of Kshs _____

All tenders must be accompanied by _____ *number of copies of the same and a*
security in the form and amount specified in the tendering documents, and must be delivered to

_____ *[address and location]*

at or before _____ *(time and date). Tenders will be opened immediately*
thereafter, in the presence of tenderers' representatives who choose to attend.

Please confirm receipt of this letter immediately in writing by cable/facsimile or telex.

Yours faithfully,

Authorised Signature
Name and Title

FORM OF TENDER

TO: _____ [Name of Employer] _____ [Date]
_____ [Name of Contract]

Dear Sir,

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, install and complete such Works and remedy any defects therein for the sum of Kshs. [Amount in figures] Kenya Shillings _____
_____ [Amount in words]
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 Appendix to Conditions of Contract.
3. We agree to abide 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.
5. We understand that you are not bound to accept the lowest or any tender you may receive.

Dated this _____ day of _____ 20 _____

Signature _____ in the capacity of _____

duly authorized to sign tenders for and on behalf of
_____ [Name of Employer]
of _____ [Address of Employer]

Witness; Name _____

Address _____

Signature _____

Date _____

APPENDIX TO FORM OF TENDER

(This appendix forms part of the tender)

| CONDITIONS OF CONTRACT | CLAUSE | AMOUNT |
|---|--------|--|
| Tender Security (Bank Guarantee only) | | Kshs |
| Amount of Performance Security (Unconditional Bank Guarantee) | 10.1 | ____percent of Tender Sum in the form of Unconditional Bank Guarantee |
| Program to be submitted | 14.1 | Not later than____days after issuance of Order to Commence |
| Cashflow estimate to be submitted | 14.3 | Not later than____days after issuance of Order to Commence |
| Minimum amount of Third Party Insurance | 23.2 | Kshs. |
| Period for commencement, from the Engineer's order to commence | 41.1 | ____days |
| Time for completion | 43.1 | |
| Amount of liquidated damages | 47.1 | Kshs. per day |
| Limit of liquidated damages | 47.1 | ____% of Contract Value |
| Defect Liability period | 49.1 | Months |
| Percentage of Retention | 60.5 | ____of Interim Payment Certificate |
| Limit of Retention Money | 60.5 | ____% of Contract Price |
| Minimum amount of interim certificates | 60.2 | Contract value/Time for completion in months |
| Time within which payment to be made after Interim Payment Certificate signed by Engineer | 60.8 | ____days |
| Time within which payment to be made after Final Payment Certificate signed by Engineer | 60.8 | ____days |
| Appointer of Arbitrator | 67(3) | Chief Justice of The Republic of Kenya |
| Notice to Employer and Engineer | 68.2 | The Employers address is: Permanent Secretary, Ministry of....., P.O.Box <u>NAIROBI</u> The Engineer's address is: Chief Engineer(.....), Ministry of....., P.O.Box..... <u>NAIROBI</u> |

Signature of Tender.....Date.....

LETTER OF ACCEPTANCE

[letterhead paper of the Employer]

_____ [date]

To: _____
[name of the Contractor]

[address of the Contractor]

Dear Sir,

This is to notify you that your Tender dated _____
for the execution of _____
[name of the Contract and identification number, as given in the Tender documents] for the Contract
Price of Kshs. _____ [amount in figures]/[Kenya
Shillings _____ (amount in words)] in accordance with the Instructions
to Tenderers is hereby accepted.

You are hereby instructed to proceed with the execution of the said Works in accordance with the
Contract documents.

Authorized Signature

Name and Title of Signatory

Attachment : Agreement

FORM OF AGREEMENT

THIS AGREEMENT, made the _____ day of _____ 20 _____
between _____ of [or whose registered office is
situated at] _____
(hereinafter called “the Employer”) of the one part AND
_____ of [or whose registered office is
situated at] _____
(hereinafter called “the Contractor”) of the other part.

WHEREAS THE Employer is desirous that the Contractor executes

_____ *(name and identification number of Contract)* (hereinafter called “the Works”) located
at _____ *[Place/location of the Works]* and the Employer has accepted
the tender submitted by the Contractor for the execution and completion of such Works and the
remedying of any defects therein for the Contract Price of Kshs
_____ *[Amount in figures]*, Kenya
Shillings _____ *[Amount in words]*.

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and shall be read and construed as part of this Agreement i.e.
 - (i) Letter of Acceptance
 - (ii) Form of Tender
 - (iii) Conditions of Contract Part I
 - (iv) Conditions of Contract Part II and Appendix to Conditions of Contract
 - (v) Specifications
 - (vi) Drawings
 - (vii) Priced Bills of Quantities
3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other

sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The common Seal of _____

Was hereunto affixed in the presence of _____

Signed Sealed, and Delivered by the said _____

Binding Signature of Employer _____

Binding Signature of Contractor _____

In the presence of (i) Name _____

Address _____

Signature _____

[ii] Name _____

Address _____

Signature _____

FORM OF TENDER SECURITY

WHEREAS (hereinafter called “the Tenderer”) has submitted his tender dated for the construction of
..... (name of Contract)

KNOW ALL PEOPLE by these presents that WE having our registered office at (hereinafter called “the Bank”), are bound unto (hereinafter called “the Employer”) in the sum of Kshs..... for which payment well and truly to be made to the said Employer, the Bank binds itself, its successors and assigns by these presents sealed with the Common Seal of the said Bank this Day of 20.....

THE CONDITIONS of this obligation are:

1. If after tender opening the tenderer withdraws his tender during the period of tender validity specified in the instructions to tenderers
Or
2. If the tenderer, having been notified of the acceptance of his tender by the Employer during the period of tender validity:
 - (a) fails or refuses to execute the form of Agreement in accordance with the Instructions to Tenderers, if required; or
 - (b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Tenderers;
 - (c) rejects a correction of an arithmetic error in the tender.

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him, owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This guarantee will remain in force up to and including thirty (30) days after the period of tender validity, and any demand in respect thereof should reach the Bank not later than the said date.

| | |
|--------------------|----------------------------------|
| _____ [date] | _____ [signature of the Bank] |
| _____ [witness] | _____ [seal] |

(Amend accordingly if provided by Insurance Company)

PERFORMANCE BANK GUARANTEE (UNCONDITIONAL)

To: _____ (Name of Employer) _____ (Date)
_____ (Address of Employer)

Dear Sir,

WHEREAS _____ (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ (hereinafter called "the Works");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognised bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Kshs. _____ (amount of Guarantee in figures) Kenya Shillings _____ (amount of Guarantee in words), and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of Kenya Shillings _____ (amount of Guarantee in words) as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change, addition or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any change, addition, or modification.

This guarantee shall be valid until the date of issue of the Certificate of Completion.

SIGNATURE AND SEAL OF THE GUARANTOR _____

Name of Bank _____

Address _____

Date _____

(Amend accordingly if provided by Insurance Company)

BANK GUARANTEE FOR ADVANCE PAYMENT

To: _____ *[name of Employer]* _____ *(Date)*
_____ *[address of Employer]*

Gentlemen,

Ref: _____ *[name of Contract]*

In accordance with the provisions of the Conditions of Contract of the above-mentioned Contract, We, _____ *[name and Address of Contractor]* (hereinafter called "the Contractor") shall deposit with _____ *[name of Employer]* a bank guarantee to guarantee his proper and faithful performance under the said Contract in an amount of Kshs. _____ *[amount of Guarantee in figures]* Kenya Shillings _____ *[amount of Guarantee in words]*.

We, _____ *[bank or financial institution]*, as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____ *[name of Employer]* on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding Kshs _____ *[amount of Guarantee in figures]* Kenya Shillings _____ *[amount of Guarantee in words]*, such amount to be reduced periodically by the amounts recovered by you from the proceeds of the Contract.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between _____ *[name of Employer]* and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

No drawing may be made by you under this guarantee until we have received notice in writing from you that an advance payment of the amount listed above has been paid to the Contractor pursuant to the Contract.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____ *(name of Employer)* receives full payment of the same amount from the Contract.

Yours faithfully,

Signature and Seal _____

Name of the Bank or financial institution _____

Address _____

Date _____

Witness: Name: _____
Address: _____
Signature: _____
Date: _____

TENDER QUESTIONNAIRE

Please fill in block letters.

1. Full names of tenderer
.....
2. Full address of tenderer to which tender correspondence is to be sent (unless an agent has been appointed below)
.....
3. Telephone number (s) of tenderer
.....
4. Telex address of tenderer
.....
5. Name of tenderer's representative to be contacted on matters of the tender during the tender period
.....
6. Details of tenderer's nominated agent (if any) to receive tender notices. This is essential if the tenderer does not have his registered address in Kenya (name, address, telephone, telex)
.....
.....

Signature of Tenderer

Make copy and deliver to: _____ (*Name of Employer*)

ANTI – CORRUPTION POLICY IN THE PROCUREMENT PROCESS

UNDERTAKING BY BIDDER ON ANTI – CORRUPTION POLICY / CODE OF CONDUCT AND COMPLIANCE PROGRAMME

The governments of Kenya is committed to fighting corruption in all its forms and in all its institutions to ensure that all the government earned revenues are utilized prudently and for the purpose intended with a view to promoting economic development as the country work towards actualizing Vision 2030.

Here at Jaramogi Oginga Odinga University of Science and Technology and also being one of the government entities mandated under the government to provide quality education and transforming lives, on behalf of the government, we are highly committed to fighting any form of corruption in our organization to ensure that all the monies that the government entrust with us, is optimally and prudently utilized for the benefits of all the people we serve.

The following is a requirement that every Bidder wishing to do business with JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY must comply with:

- (1) Each bidder must submit a statement, as part of the tender documents, in the format given and which must be signed personally by the Chief Executive Officer or other appropriate senior corporate officer of the bidding company and, where relevant, of its subsidiary in Kenya. If a tender is submitted by a subsidiary, a statement to this effect will also be required of the parent company, signed by its Chief Executive Officer or other appropriate senior corporate officer.
- (2) Bidders will also be required to submit similar No-bribery commitments from their subcontractors and consortium partners; the bidder may cover the subcontractors and consortium partners in its own statement, provided the bidder assumes full responsibility.
- (3)
 - a) Payment to agents and other third parties shall be limited to appropriate compensation for legitimate services.
 - b) Each bidder will make full disclosure in the tender documentation of the beneficiaries and amounts of all payments made, or intended to be made, to agents or other third parties (including political parties or electoral candidates) relating to the tender and, if successful, the implementation of the contract.
 - c) The successful bidder will also make full disclosure [quarterly or semi- annually] of all payments to agents and other third parties during the execution of the contract.
 - d) Within six months of the completion of the performance of the contract, the successful bidder will formally certify that no bribes or other illicit commissions have been paid. The final accounting shall include brief details of the goods and services provided that are sufficient to establish the legitimacy of the payments made.
 - e) Statements required according to subparagraphs (b) and (d) of this paragraph will have to be certified by the company's Chief Executive Officer, or other appropriate senior corporate officer.
- (4) Tenders which do not conform to these requirements shall not be considered.

- (5) If the successful bidder fails to comply with its No-bribery commitment, significant sanctions will apply. The sanctions may include all or any of the following:
- a) Cancellation of the contract;
 - b) Liability for damages to the public authority and/or the unsuccessful competitors in the bidding possibly in the form of a lump sum representing a pre-set percentage of the contract value (liquidated).
- (6) Bidders shall make available, as part of their tender, copies of their anti-Bribery Policy/Code of Conduct, if any, and of their-general or project - specific - Compliance Program.
- (7) The Government of Kenya through Ethics and Anti-Corruption Commission has made special arrangements for adequate oversight of the procurement process and the execution of the contract. Those charged with the oversight responsibility will have full access if need be to all documentation submitted by Bidders for this contract, and to which in turn all Bidders and other parties involved or affected by the project shall have full access (provided, however, that no proprietary information concerning a bidder may be disclosed to another bidder or to the public).

1. MEMORANDUM (FORMAT)

(Clause 46 of Kenya Public Procurement and Asset Disposal Act 2015)

This company_____(*name of company*) has issued, for the purposes of this tender, a Compliance Program copy attached -which includes all reasonable steps necessary to assure that the No-bribery commitment given in this statement will be complied with by its managers and employees, as well as by all third parties working with this company on the public sector projects or contract including agents, consultants, consortium partners, subcontractors and suppliers')"

Authorized Signature:_____

Name and Title of Signatory: _____

Name of Bidder: _____

Address: _____

CONFIDENTIAL BUSINESS QUESTIONNAIRE

You are requested to give the particulars indicated in Part 1 and either Part 2 (a), 2 (b) or 2 (c) and 2 (d) whichever applies to your type of business.

You are advised that it is a serious offence to give false information on this Form.

Part 1 – General

Business Name

Location of business premises; Country/Town.....

Plot No..... Street/Road

Postal Address..... Tel No.....

Nature of Business.....

Current Trade Licence No..... Expiring date.....

Maximum value of business which you can handle at any time: K.
pound.....

Name of your bankers.....

Branch.....

Part 2 (a) – Sole Proprietor

Your name in full..... Age.....

Nationality..... Country of Origin.....

*Citizenship details

Part 2 (b) – Partnership

Give details of partners as follows:

| | <i>Name in full</i> | <i>Nationality</i> | <i>Citizenship Details</i> | <i>Shares</i> |
|----|---------------------|--------------------|----------------------------|---------------|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |

Part 2(c) – Registered Company:

Private or public.....

State the nominal and issued capital of the Company-

Nominal Kshs.....

Issued Kshs.....

Give details of all directors as follows:

Name in full . Nationality. Citizenship Details*. Shares.

1.
.....

2.
.....

3.
.....

4.
.....

Part 2(d) – Interest in the Firm:

Is there any person / persons in.....(*Name of Employer*) who has interest in this firm? Yes/No... (*Delete as necessary*)

I certify that the information given above is correct.

.....
(*Title*)

.....
(*Signature*)

.....
(*Date*)

* Attach proof of citizenship

STATEMENT OF FOREIGN CURRENCY REQUIREMENTS

(See Clause 60[5] of the Conditions of Contract)

In the event of our Tender for the execution of _____
_____ (*name of Contract*) being accepted, we would
require in accordance with Clause 21 of the Conditions of Contract,
which is attached hereto, the following percentage:

(Figures)..... (Words).....

of the Contract Sum, (Less Fluctuations) to be paid in foreign currency.

Currency in which foreign exchange element is required:

.....

Date: The Day of 20.....

Enter 0% (zero percent) if no payment will be made in foreign currency.

Maximum foreign currency requirement shall be _____ (percent)
of the Contract Sum, less Fluctuations.

(Signature of Tenderer)

SCHEDULE OF MATERIALS;-BASIC PRICES
(Ref: Clause 70 of Conditions of Contract)

| MATERIAL | UNIT | ORIGIN AND PRICE | | | TRANSPORT ATION COST FROM SOURCE OF ORIGIN | |
|-------------------------------------|------|----------------------|----------|-------|---|-----------------|
| | | COUNTRY OF ORIGIN | SUPPLIER | PRICE | MODE | PRICE (KSHS) |
| Cement | Mg | | | | | |
| Lime | Mg | | | | | |
| Sand | Mg | | | | | |
| Aggregate | Mg | | | | | |
| Diesel | L | | | | | |
| Regular Petrol | L | | | | | |
| Super Petrol | L | | | | | |
| Kerosene | L | | | | | |
| Structural steel | Mg | | | | | |
| Gabion Mesh | M2 | | | | | |
| Reinforcement Steel | Mg | | | | | |
| Explosives | Kg | | | | | |
| Oil and Lubricants | L | | | | | |
| Bitumen Emulsion A3 | L | | | | | |
| Bitumen Emulsion A4 | L | | | | | |
| Bitumen Emulsion K1 | L | | | | | |
| Bitumen Emulsion K3 | L | | | | | |
| Bitumen 80/100 | Kg | | | | | |
| Bitumen MC 30 | ML | | | | | |
| Bitumen MC 70 | L | | | | | |
| Bitumen MC 3000 | L | | | | | |
| Ammonium nitrate for blasting | Kg | | | | | |

I certify that the above information is correct.

.....
 (Title)

.....
 (Signature)

.....
 (Date)

The prices inserted above shall be those prevailing 30 days before the submission of Tenders and shall be quoted in Kenya Shillings using the exchange rates specified in the Appendix to Form of Tender.

Prices of imported materials to be quoted CIF Mombasa or Nairobi as appropriate depending on whether materials are imported by the tenderer directly or through a local agent.

Transportation costs for imported materials to be quoted from Mombasa or Nairobi as appropriate to _____ (Contract Site) depending on whether materials are imported directly by the tenderer or through a local agent.

LETTER OF NOTIFICATION OF AWARD

Address of Procuring Entity

To: _____

RE: Tender No. _____

Tender Name _____

This is to notify that the contract/s stated below under the above mentioned tender have been awarded to you.

1. Please acknowledge receipt of this letter of notification signifying your acceptance.
2. The contract/contracts shall be signed by the parties within 30 days of the date of this letter but not earlier than 14 days from the date of the letter.
3. You may contact the officer(s) whose particulars appear below on the subject matter of this letter of notification of award.

(*FULL PARTICULARS*) _____

SIGNED FOR ACCOUNTING OFFICER

ANTI – CORRUPTION POLICY IN THE PROCUREMENT PROCESS

UNDERTAKING BY BIDDER ON ANTI – CORRUPTION POLICY / CODE OF CONDUCT AND COMPLIANCE PROGRAMME

The governments of Kenya is committed to fighting corruption in all its forms and in all its institutions to ensure that all the government earned revenues are utilized prudently and for the purpose intended with a view to promoting economic development as the country work towards actualizing Vision 2030.

Here at Jaramogi Oginga Odinga University of Science and Technology and also being one of the government entities mandated under the government to provide quality education and transforming lives, on behalf of the government, we are highly committed to fighting any form of corruption in our organization to ensure that all the monies that the government entrust with us, is optimally and prudently utilized for the benefits of all the people we serve.

The following is a requirement that every Bidder wishing to do business with JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY must comply with:

- (1) Each bidder must submit a statement, as part of the tender documents, in the format given and which must be signed personally by the Chief Executive Officer or other appropriate senior corporate officer of the bidding company and, where relevant, of its subsidiary in Kenya. If a tender is submitted by a subsidiary, a statement to this effect will also be required of the parent company, signed by its Chief Executive Officer or other appropriate senior corporate officer.
- (2) Bidders will also be required to submit similar No-bribery commitments from their subcontractors and consortium partners; the bidder may cover the subcontractors and consortium partners in its own statement, provided the bidder assumes full responsibility.
- (3)
 - a) Payment to agents and other third parties shall be limited to appropriate compensation for legitimate services.
 - b) Each bidder will make full disclosure in the tender documentation of the beneficiaries and amounts of all payments made, or intended to be made, to agents or other third parties (including political parties or electoral candidates) relating to the tender and, if successful, the implementation of the contract.
 - c) The successful bidder will also make full disclosure [quarterly or semi- annually] of all payments to agents and other third parties during the execution of the contract.
 - d) Within six months of the completion of the performance of the contract, the successful bidder will formally certify that no bribes or other illicit commissions have been paid. The final accounting shall include brief details of the goods and services provided that are sufficient to establish the legitimacy of the payments made.
 - e) Statements required according to subparagraphs (b) and (d) of this paragraph will have to be certified by the company's Chief Executive Officer, or other appropriate senior corporate officer.
- (4) Tenders which do not conform to these requirements shall not be considered.

- (5) If the successful bidder fails to comply with its No-bribery commitment, significant sanctions will apply. The sanctions may include all or any of the following:
 - c) Cancellation of the contract;
 - d) Liability for damages to the public authority and/or the unsuccessful competitors in the bidding possibly in the form of a lump sum representing a pre-set percentage of the contract value (liquidated).
- (6) Bidders shall make available, as part of their tender, copies of their anti-Bribery Policy/Code of Conduct, if any, and of their-general or project - specific - Compliance Program.
- (7) The Government of Kenya through Ethics and Anti-Corruption Commission has made special arrangements for adequate oversight of the procurement process and the execution of the contract. Those charged with the oversight responsibility will have full access if need be to all documentation submitted by Bidders for this contract, and to which in turn all Bidders and other parties involved or affected by the project shall have full access (provided, however, that no proprietary information concerning a bidder may be disclosed to another bidder or to the public).

2. MEMORANDUM (FORMAT)

(Clause 46 of Kenya Public Procurement and Asset Disposal Act 2015)

This company_____(*name of company*) has issued, for the purposes of this tender, a Compliance Program copy attached -which includes all reasonable steps necessary to assure that the No-bribery commitment given in this statement will be complied with by its managers and employees, as well as by all third parties working with this company on the public sector projects or contract including agents, consultants, consortium partners, subcontractors and suppliers')"

Authorized Signature:_____

Name and Title of Signatory: _____

Name of Bidder: _____

Address:

NON-DEBARMENT STATEMENT

I/We/Messrs..... of
.....Street/avenue,Building, P. O. Box.....Code, of..... (Town),
..... (Nationality), Phone: E-mail
declare that I/We /Messrs
.....

are not debarred from participating in public procurement by the Public Procurement Oversight
Authority pursuant to section 115 of the Public Procurement and Disposal Act, 2005.

Dated thisday of 20.....

Authorized Signature.....Official Stamp

Name and Title of Signatory.....

STATEMENT OF COMPLIANCE

- a) I confirm compliance of all clauses of the General Conditions, General Specifications and Particular Specifications in this tender.
- b) I confirm I have not made and will not make any payment to any person, who can be perceived as an inducement to win this tender.

Signed:for and on behalf of the Tenderer

Date:

Official

Rubber

Stamp:

.....

**DETAILS OF LITIGATIONS OR ARBITRATION PROCEEDINGS
IN WHICH THE TENDERER IS INVOLVED AS ONE OF THE PARTIES**

1. .
2. .
3. .
4. .
5. .
6. .
7. .
8. .
9. .
- 10 .

REPUBLIC OF KENYA
PUBLIC PROCUREMENT ADMINISTRATIVE REVIEW BOARD

APPLICATION NO.....OF.....20.....

BETWEEN

.....APPLICANT

AND

.....RESPONDENT (*Procuring Entity*)

Request for review of the decision of the..... (*Name of the Procuring Entity*) of dated the...day of20.....in the matter of Tender No.....of..... 20...

REQUEST FOR REVIEW

I/We.....,the above named Applicant(s), of address: Physical address.....Fax No.....Tel. No.....Email, hereby request the Public Procurement Administrative Review Board to review the whole/part of the above mentioned decision on the following grounds , namely:-

- 1.
- 2.
- etc.

By this memorandum, the Applicant requests the Board for an order/orders that: -

- 1.
- 2.
- etc

SIGNED..... (Applicant)

Dated on.....day of/...20...

FOR OFFICIAL USE ONLY

Lodged with the Secretary Public Procurement Administrative Review Board on day of20.....

SIGNED
Board Secretary

EVALUATION CRITERIA

Technical Evaluation Form: The tenderer is expected to complete Part 1 and 3 of this form

Part A: General Information

| |
|------------------------------------|
| Tenderer Name..... |
| Postal Address..... |
| Telephone (Office).....Mobile..... |
| Physical Address..... |

Part B: Evaluation Stages

Stage 1: Mandatory Requirements

*Applicants **must** qualify in all the requirements below for them to proceed to the Evaluation Stage 2- Technical evaluation*

| S/No | Mandatory requirement |
|------|--|
| 1 | Must provide National Construction Authority (NCA) Category 3 and above registration certificate under the category of Electrical Installation. In the event of a joint venture, the certificate maybe submitted by any one of the members of the venture. |
| 2 | Electrical Installations Sub-Contractors must have a current (Energy Regulatory Commission), ERC, class A license. (provide Copy of current annual license) |
| 3 | Solar PV Installations Sub-Contractors must have a current (Energy Regulatory Commission), ERC license as a Solar Water Heating Contractor. (provide Copy of current annual license) |
| 4 | Must provide Copy of current annual contractors practicing license from National Construction Authority (NCA). In the event of a joint venture, the certificate will be submitted by the holder of the NCA registration certificate. |
| 5 | Must provide Detailed Company profile. |
| 6 | Must provide certified copy of Certificate of Incorporation. If joint venture, ALL member of the venture shall submit their respective certificates. |
| 7 | Must attach proof of certified Company Ownership (CR12). |
| 8 | Must attach certified copy of Single Business Permit for the year 2020 |
| 9 | Must provide valid Certificate of Tax Compliance from Kenya Revenue Authority; (certified copy). If joint venture, ALL member of the venture shall submit their respective certificates. |
| 10 | Must Dully fill, sign and stamp the Form of Tender. |
| 11 | Must attach Certified Audited financial reports prepared by registered Auditors for the last three consecutive years for the years ended 2017, 2018 and 2019. |
| 12 | Must Dully fill, sign and stamp the Confidential Business Questionnaire |
| 13 | Must Provide Dully filled, signed and stamped Non-Debarment Declaration Form. |
| 14 | Must Provide Dully signed and signed/stamped Litigation Declaration Form.) |
| 15 | Site visit/ pre-tender conference is mandatory (as indicated in the advertisement) |
| 16 | Must provide a bid bond of 2% of the tender amount from a commercial bank recognized by CBK and must be valid for 120 days from the date of tender closing. |
| 17 | Must provide Manufacturers letter of Authority for the specified equipment |
| 18 | Must dully fill sign and stamp the Anti-corruption declaration form |
| 19 | Must Provide proof of Power of attorney of Tender Signatory in the event of a joint |

Stage 2: Technical Evaluation

Award of points for the Technical Evaluation shall be as shown in Table 1 below:

| Item | Description | Points Scored | Max Points | Total Points |
|------|---|---------------|------------|--------------|
| 1. | Key Personnel (Attach evidence) | | | 25 |
| | a) Project Engineer qualification <ul style="list-style-type: none">• Holder of Degree ----- 5 marks• Holder of Diploma ----- 3marks• Holder of Certificate ----- 0 marks | | 5 | |
| | b) Project Engineer’s experience <ul style="list-style-type: none">• Over ten (10) year relevant experience -- 5 marks• Five (5) to ten (10) years relevant experience --- ----- 4 marks• Under five (5) years relevant experience-----2 marks• No experience ----- 0 marks | | 5 | |
| | c) Works Inspector Qualification <ul style="list-style-type: none">• Holder of Degree in electrical engineering ----- -- 5 marks• Holder of Diploma in electrical engineering ----- --- 3 marks• Holder of Certificate in relevant engineering ----- ---- 1 mark• No Qualification----- 0 marks | | 5 | |
| | d) Works Inspector’s Experience <ul style="list-style-type: none">• Over 10 years’ relevant experience ----- 5 marks• Five (5) to ten (10) years’ relevant experience -- ----- 3 marks• Under 5 years’ relevant experience ----- 1 marks• No experience-----0 marks | | 5 | |
| | e) Experience of Site Technicians with minimum of certificate qualification in relevant Engineering field <ul style="list-style-type: none">• Over 10 years’ relevant experience -----5 marks• Five (5) to ten (10) relevant experience ----- 3 marks• Under 5 years’ relevant experience ----- 1mark• No relevant experience----- 0 marks | | 5 | |

| Item | Description | Points Scored | Max Points | Total Points |
|------|---|---------------|------------|--------------|
| 2. | <p>Contracts completed in the last five (5) years; a max of 5 No. projects (Attach evidence in form of completion certificates or letters from clients/consultants.)</p> <ul style="list-style-type: none"> • Project of similar nature, complexity and magnitude of equal or higher value. ----- 5 marks each • Project of similar nature and complexity but of lower magnitude than the one in consideration ----- 3 marks each • No completed project of similar nature ----- 0 marks | | 25 | 25 |
| 3 | <p>On-going projects (A max of 2 No. projects) (Attach evidence; Letters of Award/ Interim certificates/ Contracts)</p> <ul style="list-style-type: none"> • Project of similar nature, complexity and magnitude ----- 5 marks each • Project of similar nature, but of lower value than the one in consideration ----- 2.5 marks each • No ongoing project of similar nature ----- 0 marks | | 10 | 10 |
| 5. | Evidence of business physical address. (Offices/Workshops). Provide copies of ownership or lease agreement documents. | | 5 | 5 |
| 6. | <p>Financial report Audited financial report (last three [3] years) - 2017-2019</p> <ul style="list-style-type: none"> • Average Annual Turnover equal or higher than to Kshs. 40.0 Million----- 15 Marks • Average Annual Turnover between Kshs. 20 Million and Kshs 39.9 Million -----10 Marks • Average Annual Turnover between Kshs. 10 Million and Kshs 19.9 Million----- 5 Marks • Average Annual Turnover below Kshs 10 Million ----- 0 Marks | | 15 | 15 |
| 7. | <p>Evidence of financial resources (cash in hand, lines of credit, overdraft facility etc.)</p> <ul style="list-style-type: none"> • Amount equivalent to or above 25% of submitted tender sum -----20 Marks • Amount equivalent to 20% but below 25% of submitted tender sum----- 15 Marks | | 20 | 20 |

| Item | Description | Points Scored | Max Points | Total Points |
|------|--|---------------|------------|--------------|
| | <ul style="list-style-type: none"> • Amount equivalent to 15% but below 20% of submitted tender sum----- 10 Marks • Amount equivalent to 10% but below 15% of submitted tender sum----- 5 Marks • Amount below 10% of submitted tender sum ----- 0 Mark | | | |
| | TOTAL | | | 100 |

Any tenderer who scores 70 points and above in this Technical Evaluation shall be considered for further evaluation.

Stage 3: Financial Evaluation

Only tenderer's who score 70% and above of the overall marks on the technical evaluation shall qualify for financial evaluation.

This will be carried out only for those tenders that have passed BOTH mandatory requirements and Technical evaluation. The client will;

1. Undertake price comparison and ranking of prices.
2. The prices shall be compared and checked for completeness including all local taxes.

Stage 4: Due Diligence and Recommendation for Award

Particulars of post – qualification if applicable. The Client may inspect the premises due diligence to seek further clarification/confirmation if necessary, to confirm authenticity/compliance of any condition of the tender/qualifications of the tenderer in line with Section 83 of the Public Procurement and Asset Disposal Act, 2015.

The tenderer shall not be awarded the Sub-Contract if they fail to pass the compliance test. The second lowest tenderer shall be considered for due diligence.

Award Criteria: The firm achieving the lowest evaluated price will be awarded the Sub-Contract in line with Section 86 of the Public Procurement and Disposal Act, 2015

Particulars of performance security; 10% of Sub-Contract sum.