TENDER FOR SUPPLY OF SCADA HARDWARE FOR SEVEN FORKS & TURKWEL HYDRO ELECTRIC POWER PLANTS –KENYA

(CITIZEN CONTRACTORS)
GUIDELINES TO PREPARATION OF BID DOCUMENT

In preparing the bid document in response to the tender, bidders are advised to note the following:

1. **Section I – Invitation to Tender**: This section gives guidelines on how and where to seek further clarification pertaining to the tender document; the form and amount of Tender Security required; where and when the tenders should be submitted; and place where tenders will be opened.

2. **Section II – Instruction to Tenderers**: This section guides tenderers on how to prepare their bid and how the tendering process will be carried out up to the award stage including notification of award to the successful bidder. “Appendix to Instruction to Tenderers” customizes clauses under Section II. Wherever there is a conflict between the provisions of the Instructions to Tenderers under Section II and the provisions of the appendix, the provisions of the appendix prevail.

3. **Evaluation Criteria**: This gives information on how the tender will be evaluated. Tenderers should be able to evaluate their bids before submission to determine in advance whether they meet the requirement of the bid or not. Through the evaluation criteria bidders will be able to note all the required documents that should be attached to the bid document.

**Checklist of Document Forming the Bid**

<table>
<thead>
<tr>
<th>No.</th>
<th>Documents forming part of the bid</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>The main sections of the tender document that includes Section I – Invitation to Tender; Section II – Instruction to Tenderers, including Appendix to Instruction to Tenderers; and Section III – General Conditions of the Contract, including Special Conditions of Contract.</td>
<td>These Sections remain as they are in the tender document.</td>
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<tr>
<td>2</td>
<td>Duly filed mandatory business questionnaire with particulars of the supplier, contractor and shall include: (i) Name of supplier (ii) Registration details (ID/Registration/Incorporation Number) (iii) Tax PIN Number (iv) List of directors, shareholders and beneficial owners (in case of a company) (v) Name of proprietor (for sole proprietor and business name) (vi) Name of partners (for partnerships) (vii) Business contact information (Telephone and Email Address) (viii) Postal Address (ix) Physical address (x) Tax compliance status (xi) Business permit /License number (xii) County of operations</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Duly filled priced schedules</td>
<td>Prices quoted to be inclusive of taxes</td>
</tr>
<tr>
<td>5</td>
<td>Duly filled and signed Form of Tender in the format provided in the tender document</td>
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<td>6</td>
<td>Duly filled and signed declaration form in the format provided</td>
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<td>7</td>
<td>Bid document to be serialized/paginated on all pages</td>
<td></td>
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<tr>
<td>8</td>
<td>Bidders to use KenGen’s tender document and ensure to align their bid to it</td>
<td></td>
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<tr>
<td>9</td>
<td>Confirmation of a bid submission Original and two Copies</td>
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SECTION I: INVITATION TO TENDER.

Kenya Electricity Generating Company Limited [KenGen] intends to replace the SCADA hardware equipment (computing & networking hardware) for seven forks plants and Turkwel. The Company invites sealed tenders from manufacturers and authorized suppliers for supply & delivery to site (DDP), of SCADA hardware equipment for Masinga, Kamburu, Gitaru, Kindaruma, Kiambere & Turkwel hydroelectric power stations in Kenya. The specifications are detailed in the Tender Documents.

Interested firms may obtain further information from:

Supply Chain Director,
Kenya Electricity Generating Company PLC (KenGen)
Tel: (254) (020) 3666000
Email: tenders@kengen.co.ke; jmuoka@kengen.co.ke; dwangariria@kengen.co.ke
Pkiambuthi@kengen.co.ke

A complete set of Tender Documents may be purchased from the Supply Chain office Stima Plaza upon payment of a non-refundable fee of one Thousand Kenya Shillings (Kshs. 1,000/-) or equivalent in USD, British pound or EURO. This amount does not include postage or courier charges. Alternatively, the tender document can be downloaded free of charge from the website www.kengen.co.ke or www.suppliers.treasury.go.ke. Bidders are advised to be checking on the above website regularly for any uploaded additional information/addendum/clarifications on this tender.

Tenders must be addressed and delivered as indicated in the Tender Documents on or before 12th February, 2020 at 2.00 p.m. and must be accompanied by a Tender Security of Kshs two million (2,000,000.00), or twenty thousand (20,000) US dollars or Eighteen thousand (18,000) Euros.

Mandatory site visit will be on Thursday, 16th January, 2020 and Wednesday, 22nd January, 2020, both at 10:00 hrs at Kamburu power station. Bidders are advised to attend one day.

Tenders will be opened in the presence of tenderer’s representatives who choose to attend on 12th February, 2020 at 2.30 p.m. at Stima Plaza II, Ground Floor.

KenGen Adheres to high standards of integrity in its business operations. Report any unethical behaviour immediately through:
KenGen Call Tip-offs Anonymous System Toll Free: 0800722626
Free Fax: 00800 007788
Email: kengen@tip-offs.com
Visit our web: www.tip-offs.com

SUPPLY CHAIN DIRECTOR
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2.1 Eligible Tenderers

2.1.1 This Invitation for Tenders is open to all tenderers eligible as described in the Invitation to Tender. Successful tenderers shall complete the supply of goods by the intended completion date specified in the Schedule of Requirements (Section VI).

2.1.2 The procuring entity’s employees, committee members, board members and their relative (spouse and children) are not eligible to participate in the tender.

2.1.3 Tenderers shall provide the qualification information statement that the tenderer (including all members of a joint venture and subcontractors) is not associated, or have been associated in the past, directly or indirectly, with a firm or any of its affiliates which have been engaged by the Procuring entity to provide consulting services for the preparation of the design, specifications, and other documents to be used for the procurement of the goods under this Invitation for tenders.

2.1.4 Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices.

2.2 Eligible Goods

2.2.1 All goods to be supplied under the contract shall have their origin in eligible source countries.

2.2.2 For purposes of this clause, “origin” means the place where the goods are mined, grown, or produced. Goods are produced when, through manufacturing, processing, or substantial and major assembly of components, a commercially-recognized product results that is substantially different in basic characteristics or in purpose or utility from its components

2.2.3 The origin of goods is distinct from the nationality of the tenderer.

2.3 Cost of Tendering

2.3.1 The Tenderer shall bear all costs associated with the preparation and submission of its tender, and the procuring entity, will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the tendering process.
2.3.2 The price to be charged for the tender document collected from the Procuring Entity shall not exceed Kshs.1,000/=. Downloaded copies are free of charge.

2.3.3 All firms found capable of performing the contract satisfactorily in accordance with the set prequalification criteria shall be prequalified.

2.4 The Tender Document

2.4.1 The tender document comprises the documents listed below and addenda issued in accordance with clause 2.6 of these instructions to Tenderers

(i) Invitation to Tender
(ii) Instructions to tenderers
(iii) General Conditions of Contract
(iv) Special Conditions of Contract
(v) Schedule of requirements
(vi) Technical Specifications
(vii) Tender Form and Price Schedules
(viii) Tender Security Form
(ix) Contract Form
(x) Performance Security Form
(xi) Manufacturer’s Authorization Form
(xii) Confidential Business Questionnaire

2.4.2 The Tenderer is expected to examine all instructions, forms, terms, and specifications in the tender documents. Failure to furnish all information required by the tender documents or to submit a tender not substantially responsive to the tender documents in every respect will be at the tenderer’s risk and may result in the rejection of its tender.

2.5 Clarification of Documents

2.5.1 A prospective tenderer requiring any clarification of the tender document may notify the Procuring entity in writing or by post at the entity’s address indicated in the Invitation to Tender. The Procuring entity will respond in writing to any request for clarification of the tender documents, which it receives not later than seven (7) days prior to the deadline for the submission of tenders, prescribed by the procuring entity. Written copies of the Procuring entities response (including an explanation of the query but without identifying the source of inquiry) will be sent to all prospective tenderers that have received the tender document.
2.5.2 The procuring entity shall reply to any clarifications sought by the tenderer within 3 days of receiving the request to enable the tenderer to make timely submission of its tender.

2.6 Amendment of Documents

2.6.1 Five (5) days to the deadline for submission of tenders, the Procuring entity, for any reason, whether at its own initiative or in response to a clarification requested by a prospective tenderer, may modify the tender documents by amendment.

2.6.1 All prospective candidates that have received the tender documents will be notified of the amendment in email and will be binding on them.

2.6.2 In order to allow prospective tenderers reasonable time in which to take the amendment into account in preparing their tenders, the Procuring entity, at its discretion, may extend the deadline for the submission of tenders.

2.7 Language of Tender

2.7.1 The tender prepared by the tenderer, as well as all correspondence and documents relating to the tender exchange by the tenderer and the Procuring entity, shall be written in English language, provided that any printed literature furnished by the tenderer may be written in another language provided they are accompanied by an accurate English translation of the relevant passages in which case, for purposes of interpretation of the tender, the English translation shall govern.

2.8 Documents Comprising of Tender

2.8.1 The tender prepared by the tenderers shall comprise the following components:

(a) a Tender Form and a Price Schedule completed in accordance with paragraph 2.9, 2.10 and 2.11 below

(b) documentary evidence established in accordance with paragraph 2.1 that the tenderer is eligible to tender and is qualified to perform the contract if its tender is accepted;
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

(c) documentary evidence established in accordance with paragraph 2.2 that the goods and ancillary services to be supplied by the tenderer are eligible goods and services and conform to the tender documents; and

(d) tender security furnished in accordance with paragraph 2.14

2.9 Tender Forms

2.9.1 The tenderer shall complete the Tender Form and the appropriate Price Schedule furnished in the tender documents, indicating the goods to be supplied, a brief description of the goods, their country of origin, quantity, and prices.

2.10 Tender Prices

2.10.1 The tenderer shall indicate on the appropriate Price Schedule the unit prices and total tender price of the goods it proposes to supply under the contract

2.10.2 Prices indicated on the Price Schedule shall include all costs including taxes, insurances and delivery to the premises of the entity.

2.10.3 Prices quoted by the tenderer shall be fixed during the Tender’s performance of the contract and not subject to variation on any account. A tender submitted with an adjustable price quotation will be treated as non-responsive and will be rejected, pursuant to paragraph 2.22

2.10.4 The validity period of the tender shall be 180 days after the date of opening of the tender (AITT 3).

2.11 Tender Currencies

2.11.1 Prices shall be quoted in Kenya Shillings unless otherwise specified in the Appendix to Instructions to Tenderers.

2.12 Tenderers Eligibility and Qualifications

2.12.1 Pursuant to paragraph 2.1 the tenderer shall furnish, as part of its tender, documents establishing the tenderers eligibility to tender and its qualifications to perform the contract if its tender is accepted.
2.12.2 The documentary evidence of the tenderers eligibility to tender shall establish to the Procuring entity’s satisfaction that the tenderer, at the time of submission of its tender, is from an eligible source country as defined under paragraph 2.1

2.12.3 The documentary evidence of the tenderers qualifications to perform the contract if its tender is accepted shall be established to the Procuring entity’s satisfaction;

(a) that, in the case of a tenderer offering to supply goods under the contract which the tenderer did not manufacture or otherwise produce, the tenderer has been duly authorized by the goods’ Manufacturer or producer to supply the goods.
(b) that the tenderer has the financial, technical, and production capability necessary to perform the contract;
(c) that, in the case of a tenderer not doing business within Kenya, the tenderer is or will be (if awarded the contract) represented by an Agent in Kenya equipped, and able to carry out the Tenderer’s maintenance, repair, and spare parts-stocking obligations prescribed in the Conditions of Contract and/or Technical Specifications.

2.13 Goods Eligibility and Conformity to Tender Documents

2.13.1 Pursuant to paragraph 2.2 of this section, the tenderer shall furnish, as part of its tender documents establishing the eligibility and conformity to the tender documents of all goods which the tenderer proposes to supply under the contract.

2.13.2 The documentary evidence of the eligibility of the goods shall consist of a statement in the Price Schedule of the country of origin of the goods and services offered which shall be confirmed by a certificate of origin issued at the time of shipment.

2.13.3 The documentary evidence of conformity of the goods to the tender documents may be in the form of literature, drawings, and data, and shall consist of:

(a) a detailed description of the essential technical and performance characteristic of the goods;
(b) a list giving full particulars, including available source and current prices of spare parts, special tools, etc., necessary for the proper and continuing functioning of the goods for a period of two (2) years, following commencement of the use of the goods by the Procuring entity (if applicable); and
(c) a clause-by-clause commentary on the Procuring entity’s Technical Specifications demonstrating substantial responsiveness of the goods and service to those specifications, or a statement of deviations and exceptions to the provisions of the Technical Specifications.
2.13.4 For purposes of the documentary evidence to be furnished pursuant to paragraph 2.13.3(c) above, the tenderer shall note that standards for workmanship, material, and equipment, as well as references to brand names or catalogue numbers designated by the Procurement entity in its Technical Specifications, are intended to be descriptive only and not restrictive. The tenderer may substitute alternative standards, brand names, and/or catalogue numbers in its tender, provided that it demonstrates to the Procurement entity’s satisfaction that the substitutions ensure substantial equivalence to those designated in the Technical Specifications.

2.14 Tender Security

2.14.1 The tenderer shall furnish, as part of its tender, a tender security for the amount specified in the Appendix to Invitation to Tenderers.

2.14.2 The tender security shall be in the amount specified in Appendix To Tenderers

2.14.3 The tender security is required to protect the Procuring entity against the risk of Tenderer’s conduct which would warrant the security’s forfeiture, pursuant to paragraph 2.14.7

2.14.4 The tender security shall be denominated in Kenya Shillings or in another freely convertible currency, and shall be in the form of an on-demand bank guarantee issued by a reputable bank located in Kenya or where the bank is located abroad, it must have a local correspondent bank. The Tender Security may also be in the form of an on-demand guarantee issued by a reputable insurance company approved by the Public procurement regulatory Authority and in the form provided in the tender documents or another form acceptable to the Procuring entity. The tender security must be valid for at least thirty (30) days beyond the validity of the tender.

2.14.5 Any tender not secured in accordance with paragraph 2.14.1 and 2.14.3 will be rejected by the Procuring entity as non-responsive, pursuant to paragraph 2.22

2.14.6 Unsuccessful Tenderer’s tender security will be discharged or returned as promptly as possible, but not later than thirty (30) days after the expiration of the period of tender validity prescribed by the Procuring entity.

2.14.7 The successful Tenderer’s tender security will be discharged upon the tenderer signing the contract, pursuant to paragraph 2.27 and furnishing the performance security, pursuant to paragraph 2.28
2.14.8 The tender security may be forfeited:

(a) if a tenderer withdraws its tender during the period of tender validity specified by the procuring entity on the Tender Form; or

(b) in the case of a successful tenderer, if the tenderer fails:

(i) to sign the contract in accordance with paragraph 2.27

or

(ii) to furnish performance security in accordance with paragraph 2.28

2.15 Validity of Tenders

2.15.1 Tenders shall remain valid for 180 days after the date of tender opening prescribed by the Procuring entity, pursuant to paragraph 2.18. A tender valid for a shorter period shall be rejected by the Procuring entity as non-responsive. (as per AITT3)

2.15.2 In exceptional circumstances, the Procuring entity may solicit the Tenderer’s consent to an extension of the period of validity. The request and the responses thereto shall be made in writing. The tender security provided under paragraph 2.14 shall also be suitably extended. A tenderer may refuse the request without forfeiting its tender security. A tenderer granting the request will not be required nor permitted to modify its tender.

2.16 Format and Signing of Tender

2.16.1 The Tenderer shall prepare two copies of the tender, clearly marking each “ORIGINAL TENDER” and “COPY 1 OF TENDER,” “COPY 2 OF TENDER,” as appropriate. In the event of any discrepancy between them, the original shall govern.

2.16.2 The original and all copies of the tender shall be typed or written in indelible ink and shall be signed by the tenderer or a person or persons duly authorized to bind the tenderer to the contract. **The latter authorization shall be indicated by written power-of-attorney accompanying the tender. All pages of the tender, except for un-amended printed literature, shall be initialed by the person or persons signing the tender.**
2.16.3 The tender shall have no interlineations, erasures, or overwriting except as necessary to correct errors made by the tenderer, in which case such corrections shall be initialed by the person or persons signing the tender.

2.17 Sealing and Marking of Tenders

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

2.17.2 The inner and outer envelopes shall:

(a) be addressed to the Procuring entity at the address given in the Invitation to Tender:

(b) bear, tender number and name in the Invitation for Tenders and the words, “DO NOT OPEN BEFORE 12th February, 2020 at 2.00 p.m.”

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

2.17.4 If the outer envelope is not sealed and marked as required by paragraph 2.17.2, the Procuring entity will assume no responsibility for the tender’s misplacement or premature opening.

2.18 Deadline for Submission of Tenders

2.18.1 Tenders must be received by the Procuring entity at the address specified under paragraph 2.17.2 no later than 12th February, 2020 at 2.00 p.m.

2.18.2 The Procuring entity may, at its discretion, extend this deadline for the submission of tenders by amending the tender documents in accordance with paragraph 2.6, in which case all rights and obligations of the Procuring entity and candidates previously subject to the deadline will therefore be subject to the deadline as extended.

2.19 Modification and Withdrawal of Tenders
2.19.1 The tenderer may modify or withdraw its tender after the tender’s submission, provided that written notice of the modification, including substitution or withdrawal of the tenders, is received by the Procuring Entity prior to the deadline prescribed for submission of tenders.

2.19.2 The Tenderer’s modification or withdrawal notice shall be prepared, sealed, marked, and dispatched in accordance with the provisions of paragraph 2.17. A withdrawal notice may also be sent by cable, telex but followed by a signed confirmation copy, postmarked not later than the deadline for submission of tenders.

2.19.3 No tender may be modified after the deadline for submission of tenders.

2.19.4 No tender may be withdrawn in the interval between the deadline for submission of tenders and the expiration of the period of tender validity specified by the tenderer on the Tender Form. Withdrawal of a tender during this interval may result in the Tenderer’s forfeiture of its tender security, pursuant to paragraph 2.14.7

2.19.5 The procuring entity may at any time terminate procurement proceedings before contract award and shall not be liable to any person for the termination.

2.19.6 The procuring entity shall give prompt notice of the termination to the tenderers and on request give its reasons for termination within 14 days of receiving the request from any tenderer.

2.20 Opening of Tenders

2.20.1 The Procuring entity will open all tenders in the presence of tenderers’ representatives who choose to attend, on **12th February, 2020 at 2.30 p.m.** and in the location specified in the Invitation to Tender. The tenderers’ representatives who are present shall sign a register evidencing their attendance.

2.20.2 The tenderers’ names, tender modifications or withdrawals, tender prices, discounts and the presence or absence of requisite tender security and such other details as the Procuring entity, at its discretion, may consider appropriate, will be announced at the opening.

2.20.3 The Procuring entity will prepare minutes of the tender opening.

2.21 Clarification of Tenders
2.21.1 To assist in the examination, evaluation and comparison of tenders the Procuring entity may, at its discretion, ask the tenderer for a clarification of its tender. The request for clarification and the response shall be in writing, and no change in the prices or substance of the tender shall be sought, offered, or permitted.

2.21.2 Any effort by the tenderer to influence the Procuring entity in the Procuring entity’s tender evaluation, tender comparison or contract award decisions may result in the rejection of the tenderers’ tender.

2.22 Preliminary Examination

2.22.1 The Procuring entity will examine the tenders to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed, and whether the tenders are generally in order (as per AITT 6)

2.22.2 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantify, the unit price shall prevail, and the total price shall be corrected. If the candidate does not accept the correction of the errors, its tender will be rejected, and its tender security forfeited. If there is a discrepancy between words and figures the amount in words will prevail.

2.22.3 The Procuring entity may waive any minor informality or non-conformity or irregularity in a tender which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any tenderer.

2.22.4 Prior to the detailed evaluation, pursuant to paragraph 2.23 the Procuring entity will determine the substantial responsiveness of each tender to the tender documents. For purposes of these paragraphs, a substantially responsive tender is one, which conforms to all the terms and conditions of the tender documents without material deviations. The Procuring entity’s determination of a tender’s responsiveness is to be based on the contents of the tender itself without recourse to extrinsic evidence.

2.22.5 If a tender is not substantially responsive, it will be rejected by the Procuring entity and may not subsequently be made responsive by the tenderer by correction of the non-conformity.

2.23 Conversion to Single Currency
2.23.1 Where other currencies are used, the procuring entity will convert these currencies to Kenya Shillings using the selling exchange rate on the date of tender closing provided by the Central Bank of Kenya.

2.24 **Technical Evaluation and Comparison of Tenders**

2.24.1 The Procuring entity will evaluate and compare the tenders which have been determined to be substantially responsive, pursuant to paragraph 2.22.

2.24.2 The tender evaluation committee shall evaluate the tender within 30 days of the validity period from the date of opening the tender. *as per AITT*

2.24.3 A tenderer who gives false information in the tender document about its qualification or who refuses to enter into a contract after notification of contract award shall be considered for debarment from participating in future public procurement.

2.25 **Preference**

2.25.1 Preference where allowed in the evaluation of tenders shall not exceed 15%.

2.26 **Contacting the Procuring entity**

2.26.1 Subject to paragraph 2.21 no tenderer shall contact the Procuring entity on any matter related to its tender, from the time of the tender opening to the time the contract is awarded.

2.26.2 Any effort by a tenderer to influence the Procuring entity in its decisions on tender, evaluation, tender comparison, or contract award may result in the rejection of the Tenderer’s tender.

2.27 **Award of Contract**

(a) **Post-qualification**

2.27.1 In the absence of pre-qualification, the Procuring entity will determine to its satisfaction whether the tenderer that is selected as having submitted the lowest evaluated responsive tender is qualified to perform the contract satisfactorily.
2.27.2 The determination will take into account the tenderer financial, technical, and production capabilities. It will be based upon an examination of the documentary evidence of the tenderer’s qualifications submitted by the tenderer, pursuant to paragraph 2.12.3 as well as such other information as the Procuring entity deems necessary and appropriate.

2.27.3 A positive determination will be a prerequisite for award of the contract to the tenderer. A negative determination will result in rejection of the Tenderer’s tender, in which event the Procuring entity will proceed to the next lowest evaluated tender to make a similar determination of that Tenderer’s capabilities to perform satisfactorily.

(b) Award Criteria

2.27.4 The Procuring entity will award the contract to the successful tenderer(s) whose tender has been determined to be substantially responsive and has been determined to be the lowest evaluated tender, provided further that the tenderer is determined to be qualified to perform the contract satisfactorily.

(c) Procuring entity’s Right to Vary quantities

2.27.5 The Procuring entity reserves the right at the time of contract award to increase or decrease the quantity of goods originally specified in the Schedule of requirements without any change in unit price or other terms and conditions

(d) Procuring entity’s Right to accept or Reject any or All Tenders

2.27.6 The Procuring entity reserves the right to accept or reject any tender, and to annul the tendering process and reject all tenders at any time prior to contract award, without thereby incurring any liability to the affected tenderer or tenderers or any obligation to inform the affected tenderer or tenderers of the grounds for the Procuring entity’s action

2.28 Notification of Award

2.28.1 Prior to the expiration of the period of tender validity, the Procuring entity will notify the successful tenderer in writing that its tender has been accepted.

2.28.2 The notification of award will constitute the formation of the Contract but will have to wait until the contract is finally signed by both parties
2.28.3 Upon the successful Tenderer’s furnishing of the performance security pursuant to paragraph 2.28, the Procuring entity will promptly notify each unsuccessful Tenderer and will discharge its tender security, pursuant to paragraph 2.14

2.29 Signing of Contract

2.29.1 At the same time as the Procuring entity notifies the successful tenderer that its tender has been accepted, the Procuring entity will send the tenderer the Contract Form provided in the tender documents, incorporating all agreements between the parties.

2.29.2 The parties to the contract shall have it signed within **fifteen (15) days** from the date of notification of contract award unless there is an administrative review request.

2.29.3 Within **fifteen (15) days** of receipt of the Contract Form, the successful tenderer shall sign and date the contract and return it to the Procuring entity.

2.30 Performance Security

2.30.1 Within **fifteen (15) days** of the receipt of notification of award from the Procuring entity, the successful tenderer shall furnish the performance security in accordance with the Conditions of Contract, in the Performance Security Form provided in the tender documents, or in another form acceptable to the Procuring entity.

2.30.2 Failure of the successful tenderer to comply with the requirements of paragraph 2.27 or paragraph 2.28 shall constitute sufficient grounds for the annulment of the award and forfeiture of the tender security, in which event the Procuring entity may make the award to the next lowest evaluated Candidate or call for new tenders.

2.31 Corrupt or Fraudulent Practices

2.31.1 The Procuring entity requires that tenderers observe the highest standard of ethics during the procurement process and execution of contracts when used in the present regulations, the following terms are defined as follows;

(i) “corrupt practice” means the offering, giving, receiving, or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution; and
(ii) “fraudulent practice” means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procuring entity, and includes collusive practice among tenderer (prior to or after tender submission) designed to establish tender prices at artificial non-competitive levels and to deprive the Procuring entity of the benefits of free and open competition;

2.31.2 The procuring entity will reject a proposal for award if it determines that the tenderer recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question.

2.31.3 Further a tenderer who is found to have indulged in corrupt or fraudulent practices risks being debarred from participating in public procurement in Kenya.
APPENDIX TO INSTRUCTIONS TO TENDERERS

The following information regarding the particulars of the tender shall complement supplement or amend the provisions of the instructions to tenderers. Wherever there is a conflict between the provision of the instructions to tenderers and the provisions of the appendix, the provisions of the appendix herein shall prevail over those of the instructions to tenderers.

**AITT: APPENDIX TO INSTRUCTIONS TO TENDERS**

<table>
<thead>
<tr>
<th>REF No.</th>
<th>INSTRUCTIONS TO TENDERERS REFERENCE</th>
<th>PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AITT 1</td>
<td>2.1</td>
<td>Eligible tenderers</td>
</tr>
<tr>
<td></td>
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<tr>
<td>AITT 2</td>
<td>2.5.1</td>
<td>Clarification</td>
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<tr>
<td>AITT 3</td>
<td>2.10.4</td>
<td>Tender Validity Period</td>
</tr>
<tr>
<td></td>
<td>2.15.1</td>
<td>Tender</td>
</tr>
<tr>
<td>REF No.</td>
<td>INSTRUCTIONS TO TENDERERS REFERENCE</td>
<td>PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>AITT 4</td>
<td>2.11 Tender Currencies</td>
<td>Tender shall be quoted in Kenya shillings, Euro or United States Dollars only</td>
</tr>
<tr>
<td>AITT 5</td>
<td>2.14.2 Tender Security amount</td>
<td>1. Tender security shall be KES 2,000,000.00 or USD 20,000 or Euro 18,000 in the form of a bank guarantee.</td>
</tr>
<tr>
<td></td>
<td>2.14.3</td>
<td>2. All Tender Security shall be strictly done by a local bank.</td>
</tr>
<tr>
<td></td>
<td>2.14.4</td>
<td>3. It shall be valid for 30 days beyond the tender validity period.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. The tender security is required to protect the Procuring conduct which would warrant the security’s forfeiture, pursuant to paragraph 2.14.7</td>
</tr>
<tr>
<td>AITT 6</td>
<td>2.17 Sealing and marking of tenders</td>
<td>(a) Bidder shall submit one original offer and two copies of the offer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) The tenderer shall also submit the tender offer in soft copy contained in Three sets of discs or Three flash memories.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The softcopy media shall be firmly attached to the volume 1 original and the two volumes 1 copy each.</td>
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<tr>
<td></td>
<td></td>
<td>(c) Price schedules in Ms excel shall be included in the soft copy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) All the documents below shall be submitted as detailed. Each page (including blank pages) must have a unique page number which are sequential from first to last page. The documents MUST be bound into at least two volumes as follows:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Volume1:</strong> Shall be submitted in hard and soft copy containing the following tendering documents arranged in the order below</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Form of tender</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Price Schedules (all the schedules) duly completed, signed and stamped</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Tender Security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Joint Venture agreement for joint ventures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Copy/copies of certificate of incorporation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Copy/ copies of Tax compliance certificate</td>
</tr>
</tbody>
</table>
**Volume 2**: Shall be submitted in **hard and soft copy** containing the

<table>
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<th>PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7. Confidential business questionnaire/s duly completed and signed plus the following appendices to the questionnaire</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(i) Customer reference for the largest single assignment you have undertaken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) Brochures or annual reports for public limited companies (for PLC’s only)</td>
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<tr>
<td></td>
<td></td>
<td>(iii) Company profile (for companies only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iv) CR12 forms for Kenyan firms (companies incorporated in Kenya)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(v) Copies of National ID’s of the directors for Kenyan firms (companies incorporated in Kenya)</td>
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<td>8. Power of Attorney of tender signatory</td>
</tr>
<tr>
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<td></td>
<td>9. Signed Supplier (bidders) Warranty</td>
</tr>
<tr>
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<td></td>
<td>10. Similar experience records of the firm/s</td>
</tr>
<tr>
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<td></td>
<td>11. Copies of completion certificates for projects listed in the similar experience record of the firm. Or copy of contract agreements and payment certificates</td>
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<tr>
<td></td>
<td></td>
<td>12. Site visit certificate, signed and stamped</td>
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<tr>
<td></td>
<td></td>
<td>13. Signed clarifications and addendums</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14. Financial information form/s and supporting documents such as</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(i) Letter of intent to finance the bidder from a local bank if applicable as per qualification criteria 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) Bank statements if applicable as per qualification criteria 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Copies of share certificates, title deeds etc. for financing purposes if applicable as per qualification criteria 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15. Audited financial statements accounts for the last three years (2016, 2017, 2018)</td>
</tr>
</tbody>
</table>
bidder’s technical proposal documents as per clause 5.1.4 of specifications arranged in the order given

1. Implementation program

2. **List** of provided manuals, catalogues, manufacturer information and technical data sheets (see clause 5.1.4.2.4(e))

3. dully filled technical schedules

4. dully filled deviation from specification schedule if applicable

5. duly filled preliminary bill of materials

6. Valid, duly signed Manufacturer’s authorization and warranty for authorized suppliers for each of the following equipment:
   - Rack mount enterprise servers,
   - Rack mount industrial PC,
   - Rack mount industrial Ethernet switches,
   - Industrial PTP grandmaster clock & time server,
   - Touch screen industrial panel PC,
   - Enterprise cyber security appliances,
   - Industrial cyber security appliances,
   - Thin clients and workstations

7. Type test reports by an EU/USA/Canadian National Standards and Testing Authority (NSTA) or by a reputable testing body or manufacturer accredited by an EU/USA/Canadian National Standards and Testing Authority (NSTA) for each of the following:
   (i) Rack mount industrial PC,
   (ii) Industrial ethernet switches,
   (iii) PTP grandmaster clock & time server
8. Product certifications UL/FCC or CEE/ROHS by an EU/USA/Canadian National Standards and Testing Authority (NSTA) or by a reputable testing body or manufacturer accredited by an EU/USA/Canadian National Standards and Testing Authority (NSTA) for each of the following:
   (i) Rack mount servers
   (ii) Rack mount workstations
   (iii) Thin client PC
   (iv) LCD monitors
   (v) Touch screen industrial panel PC
   (vi) Industrial Cyber security appliances
   (vii) Enterprise cyber security appliance

9. **Cyber security solution Vendor** qualification documents
   (the documents below shall be from the cyber security solution provider and not necessarily from the bidder):
   (i) Cyber security solution vendor business permit of the local Kenyan office or certificate of incorporation in Kenya.
   (ii) Cyber security solution vendor CV’s of local Kenyan personnel
   (iii) At least five (5) Published Gartner Magic Quadrant (MQ) reports over the last five years that show the vendor’s leadership positions in enterprise network firewalls. *(bidder to attach only the summary pages of the report showing the magic quadrant in hard copy, the full reports to be provided in soft copy)*
   (iv) At least Three (3) published NSS labs NGFW test reports over the last 3 years that show the vendor’s solution/platform overall exploit block rate of over 98%. *(bidder to attach only the summary pages of*
### Instructions to tenderers

#### Reference No.

<table>
<thead>
<tr>
<th>REF No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>AITT 7</td>
<td>2.18.3 Tender Closing date</td>
<td>the report showing the tests done and the results in hard copy, the full reports to be provided in soft copy)</td>
</tr>
<tr>
<td>AITT 8</td>
<td>2.22 Preliminary Examination</td>
<td>At least Two (2) published NSS Labs Breach Prevention reports over the last three years showing the vendors solution/platform has a security effectiveness of over 98%. Bidder to attach only the summary pages of the report showing the tests done and the results in hard copy, the full report to be provided in soft copy)</td>
</tr>
<tr>
<td>AITT 9</td>
<td>2.24 Technical Evaluation and Comparison of Tenders</td>
<td>Web hyperlinks to publicly available documents as per requirements in evaluation criteria and clause 5.4.5.2</td>
</tr>
<tr>
<td>AITT 10</td>
<td>2.25.1 Preference</td>
<td>Other documents from Cyber security solution vendor that shows that their platform/software/solution meets tender requirements. (bulk documents to be provided in soft copy only)</td>
</tr>
<tr>
<td>AITT 11</td>
<td>2.27 (a) Post Qualification</td>
<td>Folder 3: shall be submitted in <a href="soft-copy-only">soft copy only</a> containing the technical manuals, data sheets and catalogues as detailed in <strong>clause 5.1.4</strong> of specifications</td>
</tr>
<tr>
<td>AITT 12</td>
<td>2.31.1 Corrupt or Fraudulent Practices</td>
<td>KenGen adheres to high standards of integrity in its business operations.</td>
</tr>
</tbody>
</table>

- **Folder 3**: shall be submitted in **soft copy only** containing the technical manuals, data sheets and catalogues as detailed in **clause 5.1.4** of specifications.
<table>
<thead>
<tr>
<th>REF No.</th>
<th>INSTRUCTIONS TO TENDERERS REFERENCE</th>
<th>PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS</th>
</tr>
</thead>
</table>
| AITT 12 | Mandatory site visit                | (i) There shall be site visits on the dates in the invitation to tender  
(ii) Site visit is mandatory, bidder is only required to attend one site visit. For joint ventures at least one partner shall attend.  
(iii) Bidder to bring along with them filled, signed and stamped site visit certificate part A (part of tender forms) and Copy/copies of ID/passport of site visit attendee/s stamped by the bidding firm and attached to the site visit certificate part A during site visit. Only bidders representative with these documents will be allowed to access the site |

Report any unethical behavior immediately to any of the provided anonymous hotline service.  
1) Call Toll Free: 0800722626  
2) Free-Fax: 00800 007788  
3) Email: kengen@tip-offs.com  
4) Website: www.tip-offs.com
EVALUATION AND COMPARISON OF TENDERS.

The bids received shall be evaluated in the stages detailed below:

(i) Stage 1. Compliance to Mandatory requirement
(ii) Stage 2. Compliance to technical requirements and capacity to deliver the contract.
(iii) Stage 3. Financial evaluation
(iv) Stage 4. Due Diligence

STAGE 1: MANDATORY REQUIREMENTS

AITT 8: PRELIMINARY EXAMINATION

The following mandatory requirements must be met not withstanding other requirements in the tender document:

Table: AITT 8

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>SCORE PASS OR FAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bid documents below have been submitted, and copies of original document and translated document has been submitted if the original document is not in English language:</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Form of Tender Duly filled, signed, stamped and valid for at least 180 days</td>
<td></td>
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<tr>
<td>1.2</td>
<td>Copy of Certificate of incorporation/registration for the bidder and for each partner in a joint venture in case of joint venture</td>
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<tr>
<td>1.3</td>
<td>Valid tender security obtained from a local bank, valid for at least 210 days</td>
<td></td>
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<tr>
<td>1.4</td>
<td>Copy of valid Tax Compliance Certificate from Kenya Revenue Authority for local companies and an equivalent tax compliance certificate/clearance from the bidder’s country of registration government tax agency for international firms. For the bidder and for each partner in a joint venture in case of joint venture</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Duly filled, signed and stamped price schedules (all the schedules). All items <strong>MUST</strong> be quoted for, to qualify.</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>Dully filled and signed Confidential business questionnaire for the bidder and for each partner in a joint venture in case of joint venture.</td>
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</tr>
<tr>
<td>1.7</td>
<td>Joint Venture agreement for joint ventures (for joint ventures only)</td>
<td></td>
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<tr>
<td>1.8</td>
<td>Power of Attorney of tender signatory</td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td><strong>Three (3)</strong> Duly filled Similar experience record of the firm in the format provided in this tender</td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>Latest Audited financial statements for the last three years 2018, 2017 &amp; 2016 for the bidder and for each partner in a joint venture in case of joint venture</td>
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</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>SCORE</th>
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<tbody>
<tr>
<td>1.11</td>
<td>Dully filled financial information form for the bidder and for each partner in a joint venture in case of joint venture</td>
<td>PASS</td>
</tr>
<tr>
<td>1.12</td>
<td>Evidence of Site Visit by the bidder or by one partner in a joint venture</td>
<td>OR</td>
</tr>
<tr>
<td>1.13</td>
<td>Signed <strong>two-year</strong> supplier warranty as detailed in technical specifications (clause 5.1.9)</td>
<td>FAIL</td>
</tr>
<tr>
<td>1.14</td>
<td>Bidders Implementation program</td>
<td></td>
</tr>
<tr>
<td>1.15</td>
<td>Dully filled technical schedules</td>
<td></td>
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<tr>
<td>1.16</td>
<td>Duly filled preliminary bill of materials</td>
<td></td>
</tr>
<tr>
<td>1.17</td>
<td><strong>List</strong> of manuals, datasheets, catalogues &amp; other technical documents provided by bidder</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>Signed clarifications and addendums (if they are issued by procuring entity)</td>
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<tr>
<td>2</td>
<td>All pages in the submitted bidders offer have been Sequentially paginated</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Bidder has submitted an original and two copies of their bid offer</td>
<td></td>
</tr>
</tbody>
</table>

**STAGE 2. COMPLIANCE TO TECHNICAL REQUIREMENTS AND CAPACITY TO DELIVER THE CONTRACT.**

**AITT 9A: Compliance to Technical Specifications**

<table>
<thead>
<tr>
<th>No.</th>
<th>DESCRIPTION</th>
<th>REFERENCE DOCUMENT IN BIDDERS OFFER</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TECHNICAL SCHEDULES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Technical schedules have been completed in their entirety by the tenderer at the time of tendering. All entries are filled, there are no blank entries</td>
<td>Technical schedules</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>All entries in the bidders guaranteed offer have been filled with numbers or descriptive statements illustrating what the bidder is offering for each given procuring entity requirement as detailed in technical schedules requirements</td>
<td>Technical schedules</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Bidder has not offered Equipment/devices with capacity, rating, constituent component quantities or performance lower than procuring entity requirements by over 10%. For all equipment in scope of supply.</td>
<td>Technical schedules, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
</tbody>
</table>
## Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

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<table>
<thead>
<tr>
<th>No.</th>
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<th>SCORE PASS / FAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>Bidders guaranteed figures are supported by documents such as technical data sheets, technical manuals, type test reports and the relevant manufacturer’s technical specification documents</td>
<td>Technical schedules, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>GENERAL INFORMATION AND REQUIREMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Bidder has submitted a complete project implementation program showing all the activities in the tender document</td>
<td>Implementation plan Gantt chart</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Bidders delivery period does not exceed 12 months</td>
<td>Implementation plan Gantt chart and bill of quantities</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Bidder shall carry out manufacture, FAT and training as per tender</td>
<td>Technical schedules, preliminary bill of materials &amp; implementation plan</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Bidder has offered 24 months warranty as per tender</td>
<td>Signed supplier warranty</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Bidder has provided manufacturer warranty for following key equipment as detailed in the technical specifications:</td>
<td>Manufacturer warranty/manufacturer authorisation, technical schedules or technical data sheets and catalogues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Four port KVM switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rack mount enterprise grade host servers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• External LTO Tape-Based Storage</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Rack mount enterprise grade Workstations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• KVM Console with Switch</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Enterprise grade thin Client PC</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• 27.0 Inch LED backlit LCD monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two-port dual display KVM switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Panel Touch Screen Industrial PC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Digital Power &amp; Energy Meter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cyber security appliances/gateways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Bidder has provided <strong>ten (10)</strong> year manufacturer warranty for each of the following:</td>
<td>Manufacturer warranty or manufacturer authorisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rack mount industrial PC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Industrial Ethernet switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PTP grandmaster clock &amp; time server</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Instructions to tenderers

## Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No.</th>
<th>DESCRIPTION</th>
<th>REFERENCE DOCUMENT IN BIDDERS OFFER</th>
<th>SCORE PASS / FAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>SCOPE OF SUPPLY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Preliminary bill of materials has been duly filled</td>
<td>Preliminary bill of materials</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>All major components in scope of supply (as detailed in the preliminary BOM) have been offered by the bidder</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Bidder has stated the equipment on offer for all major components in scope of supply</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Technical data sheets/catalogue/manuals have been provided for all major components in scope of supply</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>All major components on offer have been offered with pre-installed licensed software as per specifications</td>
<td>Preliminary bill of materials, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>All software and software licenses have been offered as detailed in scope of supply</td>
<td>Preliminary bill of materials</td>
<td></td>
</tr>
<tr>
<td>3.7</td>
<td>All software licenses on offer are perpetual except where it has been allowed for in technical specifications</td>
<td>Preliminary bill of materials, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>3.8</td>
<td>All spares have been offered</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>3.9</td>
<td>Bidder has offered training as detailed in scope of supply</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>3.10</td>
<td>Bidder has offered commissioning support as detailed in scope of supply</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>3.11</td>
<td>Bidder has offered online support as detailed scope of supply</td>
<td>Preliminary bill of materials &amp; bidders’ scope of supply (if provided separately)</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>DESCRIPTION</td>
<td>REFERENCE DOCUMENT IN BIDDERS OFFER</td>
<td>SCORE PASS/FAIL</td>
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<tr>
<td>4</td>
<td><strong>TYPE TEST REPORTS</strong></td>
<td></td>
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<tr>
<td></td>
<td>Type test reports by an EU/USA/Canadian National Standards and Testing Authority (NSTA) or by a reputable testing body/manufacturer accredited by an EU/USA/Canadian National Standards and Testing Authority (NSTA) has been provided:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>to proof that the industrial PC’s offered has been type tested as detailed in clause 5.4.1.3.5</td>
<td>Type test reports</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>to proof that the industrial ethernet switches offered has been type tested as detailed in clause 5.4.1.4.3</td>
<td>Type test reports</td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>to proof that the PTP Grandmaster clock/Time servers has been type tested as detailed in clause 5.4.1.5.4</td>
<td>Type test reports</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>PRODUCT CERTIFICATIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product certifications UL/FCC or CEE/ROHS by an EU/USA/Canadian National Standards and Testing Authority (NSTA) or by a reputable testing body/manufacturer accredited by an EU/USA/Canadian National Standards and Testing Authority (NSTA) has been provided to proof that each of the following devices has tested and approved for use in the EU or USA or Canada.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Rack mount servers</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Rack mount work stations</td>
<td>Product certificates</td>
<td></td>
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<tr>
<td>5.3</td>
<td>Thin client PC</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>LCD monitors</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Touch screen industrial PC</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>Industrial Cyber security appliances/gateways</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>5.7</td>
<td>Enterprise cyber security appliances/gateways</td>
<td>Product certificates</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>ENVIRONMENTAL RATING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>All equipment on offer meets the environmental rating given in specifications</td>
<td>Technical schedules, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>DESCRIPTION</td>
<td>REFERENCE DOCUMENT IN BIDDERS OFFER</td>
<td>SCORE PASS/FAIL</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>6.2</td>
<td>Industrial Cyber security appliances, rack mount industrial PC, industrial Ethernet switches, PTP Grandmaster clock/Time servers, Touch Screen Industrial panel PC and thin client PC’s offered contain no moving parts and utilise fan less/passive cooling.</td>
<td>Technical schedules, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>All equipment on offer are rated for operation at a continuous ambient temperature of 35°C and 80% humidity at an altitude equal or above 1000m ASL without derating.</td>
<td>Technical schedules, technical data sheets, manufacturer catalogue &amp; manuals</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CYBER SECURITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>The cyber security solution vendor MUST have a minimum of 10 years in the security market- bidder has provided a publicly available document to ascertain this</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals, website address, other manufacturer documentation</td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>The cyber security solution vendor MUST have a local office with local personnel capable of handling OT and IT security solutions maintenance and support. Bidder has attached cyber security solution vendor business permit of the local Kenyan office or certificate of incorporation in Kenya and CV’s of local Kenyan personnel available for cyber security support</td>
<td>Cyber security solution provider business permit of the local Kenyan office or certificate of incorporation in Kenya. and CV’s of local Kenyan personnel available for cyber security support</td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>The cyber security solution vendor MUST attach and reference at least five (5) published Gartner Magic Quadrant (MQ) reports over the last 5 years that show the vendor’s leadership positions in Enterprise Network Firewalls.</td>
<td>Published Gartner Magic Quadrant (MQ) reports for Enterprise Network Firewalls</td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>The cyber security solution vendor MUST attach and reference at least Three (3) published NSS labs NGFW test reports over the last three years that show the vendor’s solution/platform overall exploit block rate of over 98%.</td>
<td>Published NSS labs NGFW test reports</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>The cyber security solution vendor MUST attach and reference at least Two (2) published NSS Labs Breach Prevention reports over the last three years showing the</td>
<td>Published NSS Labs Breach Prevention reports</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>DESCRIPTION</td>
<td>REFERENCE DOCUMENT IN BIDDERS OFFER</td>
<td>SCORE PASS / FAIL</td>
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<tr>
<td></td>
<td>vendors solution/platform has a security effectiveness of over 98%</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals, website address, other manufacturer documentation</td>
<td></td>
</tr>
<tr>
<td>7.6</td>
<td>Bidder has attached a publicly accessible reference document confirming that their cyber security solution/software/platform) offers all the functions in clause 5.4.5.3</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals, website address, other manufacturer documentation</td>
<td></td>
</tr>
<tr>
<td>7.7</td>
<td>The offered cyber security appliances/gateways offer and support all the functions stated in clause 5.4.5.2.5. A publicly available document has been provided to verify this</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals, website address, other manufacturer documentation</td>
<td></td>
</tr>
<tr>
<td>7.8</td>
<td>The offered cyber security appliances/gateways offer and support application control for SCADA protocols listed in clause 5.4.5.5.1(g). A publicly available document has been provided to verify this</td>
<td>Technical data sheets, manufacturer catalogue &amp; manuals, website address, other manufacturer documentation</td>
<td></td>
</tr>
<tr>
<td>7.9</td>
<td>All Cyber security equipment and services offered are from the same vendor</td>
<td>Preliminary bill of materials, technical data sheets and catalogues</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>BILL OF QUANTITIES</td>
<td>Price Schedules</td>
<td>Price Schedules</td>
</tr>
<tr>
<td>8.1</td>
<td>All the Bill of quantities entries have been filled. All goods and services have been offered/quoted for</td>
<td>Price Schedules</td>
<td></td>
</tr>
<tr>
<td>8.2</td>
<td>There are no substantial errors in the bill of quantities such as: major differences between the totals computed from the given unit costs multiplied by quantities and the stated total costs, error in entering the quantities and hence the totals omission of some sub totals or some items from the overall total major discrepancy between the bill of quantities total and sum taken to form of tender</td>
<td>Price Schedules</td>
<td></td>
</tr>
</tbody>
</table>
### AITT 9B: Qualification Criteria

Bidder shall be evaluated to confirm they have the capability to carry out the contract if awarded. Bidder shall ensure they meet all the requirements stipulated below and all the required documents have been submitted.

**Table: AITT 9B**

<table>
<thead>
<tr>
<th>No.</th>
<th>Qualification Criteria</th>
<th>Compliance Requirements</th>
<th>Documentation Submission Requirements</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Subject</td>
<td></td>
<td>Documentati on</td>
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<tr>
<td></td>
<td>Requirement</td>
<td>Single Entity</td>
<td>Joint Venture</td>
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<td></td>
<td></td>
<td></td>
<td>All Parties Combined</td>
</tr>
<tr>
<td>1</td>
<td>Manufacturer Authorizations</td>
<td>Must meet requirement</td>
<td>Existing or intended JV must meet requirement</td>
</tr>
<tr>
<td></td>
<td>bidder is an authorised supplier of offered rack mount servers, rack mount industrial PC, Industrial Ethernet switches, Industrial PTP grandmaster clock &amp; time server, Industrial panel PC, Enterprise cyber security appliances, industrial cyber security appliances, thin client PC and workstations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Conflict of Interest</td>
<td>Must meet requirement</td>
<td>Existing or intended JV must meet requirement</td>
</tr>
<tr>
<td></td>
<td>No conflict of interest as per clause 2.1 of instruction to tenderers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>corrupt and fraudulent practices</td>
<td>Must meet requirement</td>
<td>Must meet requirement</td>
</tr>
<tr>
<td></td>
<td>Tenderers shall not be under a declaration of ineligibility for corrupt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Qualification Criteria

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
<th>Requirement</th>
<th>Compliance Requirements</th>
<th>Documentation Submission Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single Entity</td>
<td>Joint Venture</td>
</tr>
<tr>
<td>4</td>
<td>firms</td>
<td>The bidder MUST have supplied in the last 8 years at least <strong>three (3)</strong> projects with ICT equipment or industrial/power control equipment or telecommunication equipment valued at least <strong>Fifty (50) million Kenya shillings</strong> for bidding firms which are owned by Kenyan citizens, above 50% shareholding (citizen contractors) and <strong>2 million US dollars / 200 million Kenya shillings</strong> for other firms. The value shall be for a single supply/project.</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>Historical Financial Performance</td>
<td>Submission of audited balance sheets and other financial statements acceptable to the Employer, for the last three [3] years (2018,2017,2016) to demonstrate the current soundness of the bidders’ financial position and its</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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**Instructions to tenderers**

February 2020

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<table>
<thead>
<tr>
<th>No.</th>
<th>Qualification Criteria</th>
<th>Compliance Requirements</th>
<th>Documentation Submission Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Average Annual Turnover</td>
<td>Minimum average annual turnover of <strong>Fifty (50) million Kenya shillings</strong> for bidding firms which are owned by Kenyan citizens, above 50% shareholding (citizen contractors) and <strong>2 million US dollars / 200 million Kenya shillings for other firms</strong>, calculated as total certified payments received for contracts in progress or completed, within the last three (3) years (2018, 2017, 2016)</td>
<td>Must meet requirement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Financial information form, Confidential business questionnaire, audited accounts and other Supporting financial documents</td>
</tr>
<tr>
<td>7</td>
<td>Financial Resources</td>
<td>The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit (specific to the works being tendered for), and other financial means, sufficient to meet cash flow of <strong>80% the bid offer price over one year</strong>, net of the Tenderer’s commitments for other contracts</td>
<td>Must meet requirement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Financial information form, audited accounts and other Supporting financial documents such as letter of intent to finance from a bank, bank statements title deeds, shares etc. and</td>
</tr>
</tbody>
</table>
### STAGE 3. FINANCIAL EVALUATION

a) Financial evaluation shall involve checking completeness of financial bids (BQ), presence of a duly filled, signed and stamped tender form and price schedule

b) For bid comparison purposes, the Employer shall consider the following:

   (i) Where software subscription license is offered (instead of perpetual licenses), except for cyber security functions as detailed in the particular specifications, the procuring entity shall add into the bidders’ price the cost of software license subscription for twelve years prior to bid comparison.

   (ii) Where other currencies are used, the procuring entity will convert these currencies to Kenya Shillings using the selling exchange rate on the date of tender closing provided by the Central Bank of Kenya before comparing all the responsive tenders.

c) Award shall be based on the total lowest evaluated price as per (b) above.

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<table>
<thead>
<tr>
<th>No.</th>
<th>Qualification Criteria</th>
<th>Compliance Requirements</th>
<th>Documentation Submission Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subject</td>
<td>Requirement</td>
<td>Single Entity</td>
</tr>
<tr>
<td></td>
<td>Bidders with three-year average annual turnover below 200 million Kenya shillings shall either provide a verifiable letter from a local bank of firm intent to finance the bidder for this specific tender if awarded. Or bidder shall provide verifiable documentation such as bank statements, liquefiable unencumbered assets (title deeds, shares, etc.) registered to the bidder that can provide cash to finance 80% of the bid price in one year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
d) Tender sum as submitted and read out during tender opening is absolute and final and shall not be subject to correction, adjustment or amendment, major deviation shall result in disqualification.

e) Tender shall be awarded as per the price read out during tender opening.

**STAGE 4. DUE DILIGENCE**

KenGen, at its own discretion, may prior to award of the tender, determine to its satisfaction whether the selected bidders have the ability to perform the contract satisfactorily and to ascertain conformance to technical requirements and specifications by carrying out a due diligence on the supplier’s premises or otherwise. Similarly in the discretion, due diligence shall be carried out only on firms that shall have passed both preliminary and the technical evaluation process.

KenGen shall also confirm the validity and authenticity / truthfulness of information and documents submitted with the bid. Documents and information found to be false or invalid shall render the bid unresponsive.
GENERAL CONDITIONS OF CONTRACT
## SECTION III: GENERAL CONDITIONS OF CONTRACT

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<td>Inspection and Tests</td>
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<td>Packing</td>
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<td>Resolution of Disputes</td>
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<td>3.19</td>
<td>Language and law</td>
</tr>
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<td>3.20</td>
<td>Force Majeure</td>
</tr>
<tr>
<td>3.21</td>
<td>Taxes</td>
</tr>
</tbody>
</table>
3.1 Definitions

In this Contract, the following terms shall be interpreted as indicated:

(a) “The Contract” means the agreement entered into between the Procuring entity and the tenderer, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

(b) “The Contract Price” means the price payable to the tenderer under the Contract for the full and proper performance of its contractual obligations.

(c) “The Goods” means all of the equipment, machinery, and/or other materials, which the tenderer is required to supply to the Procuring entity under the Contract.

(d) “The Procuring entity” means the organization purchasing the Goods under this Contract.

(e) “The Tenderer” means the individual or firm supplying the Goods under this Contract.

3.2 Application

These General Conditions shall apply in all Contracts made by the Procuring entity for the procurement installation and commissioning of equipment.

3.3 Country of Origin

For purposes of this clause, “Origin” means the place where the Goods were mined, grown or produced.

The origin of Goods and Services is distinct from the nationality of the tenderer.

3.4 Standards

The Goods supplied under this Contract shall conform to the standards mentioned in the Technical Specifications.
3.5 **Use of Contract Documents and Information**

3.5.1 The tenderer shall not, without the Procuring entity’s prior written consent, disclose the Contract, or any provision therefore, or any specification, plan, drawing, pattern, sample, or information furnished by or on behalf of the Procuring entity in connection therewith, to any person other than a person employed by the tenderer in the performance of the Contract.

3.5.2 The tenderer shall not, without the Procuring entity’s prior written consent, make use of any document or information enumerated in paragraph 3.5.1 above.

3.5.3 Any document, other than the Contract itself, enumerated in paragraph 3.5.1 shall remain the property of the Procuring entity and shall be returned (all copies) to the Procuring entity on completion of the Tenderer’s performance under the Contract if so required by the Procuring entity.

3.6 **Patent Rights**

3.6.1 The tenderer shall indemnify the Procuring entity against all third-party claims of infringement of patent, trademark, or industrial design rights arising from use of the Goods or any part thereof in the Procuring entity’s country.

3.7 **Performance Security**

3.7.1 Within **fifteen (15) days** of receipt of the notification of Contract award, the successful tenderer shall furnish to the Procuring entity the performance security in the amount specified in Special Conditions of Contract.

3.7.2 The proceeds of the performance security shall be payable to the Procuring entity as compensation for any loss resulting from the Tenderer’s failure to complete its obligations under the Contract.

3.7.3 The performance security shall be denominated in the currency of the Contract, or in a freely convertible currency acceptable to the Procuring entity and shall be in the form of a bank guarantee or an irrevocable letter of credit issued by a reputable bank located in Kenya or abroad, acceptable to the Procuring entity, in the form provided in the tender documents.
3.7.4 The performance security will be discharged by the Procuring entity and returned to the Candidate not later than thirty (30) days following the date of completion of the Tenderer’s performance obligations under the Contract, including any warranty obligations, under the Contract.

3.8 Inspection and Tests

3.8.1 The Procuring entity or its representative shall have the right to inspect and/or to test the goods to confirm their conformity to the Contract specifications. The Procuring entity shall notify the tenderer in writing in a timely manner, of the identity of any representatives retained for these purposes.

3.8.2 The inspections and tests may be conducted in the premises of the tenderer or its subcontractor(s), at point of delivery, and/or at the Goods’ final destination. If conducted on the premises of the tenderer or its subcontractor(s), all reasonable facilities and assistance, including access to drawings and production data, shall be furnished to the inspectors at no charge to the Procuring entity.

3.8.3 Should any inspected or tested goods fail to conform to the Specifications, the Procuring entity may reject the equipment, and the tenderer shall either replace the rejected equipment or make alterations necessary to make specification requirements free of costs to the Procuring entity.

3.8.4 The Procuring entity’s right to inspect, test and where necessary, reject the goods after the Goods’ arrival shall in no way be limited or waived by reason of the equipment having previously been inspected, tested and passed by the Procuring entity or its representative prior to the equipment delivery.

3.8.5 Nothing in paragraph 3.8 shall in any way release the tenderer from any warranty or other obligations under this Contract.

3.9 Packing

3.9.1 The tenderer shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in the Contract.

3.9.2 The packing, marking, and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract.
3.10 **Delivery and Documents**

3.10.1 Delivery of the Goods shall be made by the tenderer in accordance with the terms specified by the Procuring entity in its Schedule of Requirements and the Special Conditions of Contract.

3.11 **Insurance**

3.11.1 The Goods supplied under the Contract shall be fully insured against loss or damage incidental to manufacturer or acquisition, transportation, storage, and delivery in the manner specified in the Special conditions of contract.

3.12 **Payment**

3.12.1 The method and conditions of payment to be made to the tenderer under this Contract shall be specified in Special Conditions of Contract.

3.12.2 Payments shall be made promptly by the Procuring entity as specified in the contract.

3.13 **Prices**

3.13.1 Prices charged by the tenderer for goods delivered and services performed under the Contract shall not, with the exception of any price adjustments authorized in Special Conditions of Contract, vary from the prices by the tenderer in its tender.

3.13.2 Contract price variations shall not be allowed for contracts not exceeding one year (12 months).

3.13.3 Where contract price variation is allowed, the variation shall not exceed 25% of the original contract price.

3.13.4 Price variation request shall be processed by the procuring entity within 30 days of receiving the request.

3.14 **Assignment**

3.14.1 The tenderer shall not assign, in whole or in part, its obligations to perform under this Contract, except with the Procuring entity’s prior written consent.
3.15 **Subcontracts**

3.15.1 The tenderer shall notify the Procuring entity in writing of all subcontracts awarded under this Contract if not already specified in the tender. Such notification, in the original tender or later, shall not relieve the tenderer from any liability or obligation under the Contract.

3.16 **Termination for default**

3.16.1 The Procuring entity may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the tenderer, terminate this Contract in whole or in part:

   (a) if the tenderer fails to deliver any or all of the goods within the period(s) specified in the Contract, or within any extension thereof granted by the Procuring entity

   (b) if the tenderer fails to perform any other obligation(s) under the Contract

   (c) if the tenderer, in the judgment of the Procuring entity has engaged in corrupt or fraudulent practices in competing for or in executing the Contract

3.16.2 In the event the Procuring entity terminates the Contract in whole or in part, it may procure, upon such terms and in such manner as it deems appropriate, equipment similar to those undelivered, and the tenderer shall be liable to the Procuring entity for any excess costs for such similar goods.

3.17 **Liquidated Damages**

3.17.1. If the tenderer fails to deliver any or all of the goods within the period(s) specified in the contract, the procuring entity shall, without prejudice to its other remedies under the contract, deduct from the contract prices liquidated damages sum equivalent to 0.5% of the delivered price of the delayed items up to a maximum deduction of 10% of the delayed goods. After this, the tenderer may consider termination of the contract.

3.18 **Resolution of Disputes**

3.18.1 The procuring entity and the tenderer shall make every effort to resolve amicably by direct informal negotiation and disagreement or dispute arising between them under or in connection with the contract.
3.18.2 If, after thirty (30) days from the commencement of such informal negotiations both parties have been unable to resolve amicably a contract dispute, either party may require adjudication in an agreed national or international forum, and/or international arbitration.

3.19 **Language and Law**

3.19.1 The language of the contract and the law governing the contract shall be English language and the Laws of Kenya respectively unless otherwise stated.

3.20 **Force Majeure**

3.20.1 The tenderer shall not be liable for forfeiture of its performance security or termination for default if and to the extent that it’s delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

3.21 **Taxes**

3.21.1 "Taxes" means all present and future taxes, levies, duties, charges, assessments, deductions or withholdings whatsoever, including any interest thereon, and any penalties and fines with respect thereto, wherever imposed, levied, collected, or withheld pursuant to any regulation having the force of law and "Taxation" shall be construed accordingly.

**Local Taxation**

3.21.2 Nothing in the Contract shall relieve the Contractor and/or his Sub-Contractors from their responsibility to pay any taxes, statutory contributions and levies that may be levied on them in Kenya in respect of the Contract. The Contract Price shall include all applicable taxes and shall not be adjusted for any of these taxes.

3.21.3 The Contractor shall be deemed to be familiar with the tax laws in the Employer's Country and satisfied themselves with the requirements for all taxes, statutory contributions and duties to which they may be subjected during the term of the Contract.

3.21.4 In instances where discussions are held between the Employer and the Contractor regarding tax matters, this shall not be deemed to constitute competent advice and hence does not absolve the Contractor of their responsibility in relation to due diligence on the tax issue as per 3.21.2 above.

**Tax Deduction**
3.21.5 If the Employer is required to make a tax deduction by Law, then the deduction shall be made from payments due to the Contractor and paid directly to the Kenya Revenue Authority. The Employer shall upon remitting the tax to Kenya Revenue Authority furnish the Contractor with the relevant tax deduction certificates.

3.21.6 Where the Contractor is paid directly by the Financiers and the Employer is not able to deduct tax, then the Contractor will be required to pay the tax deduction to Kenya Revenue Authority in the name of the Employer and furnish the Employer with an original receipt thereof as evidence of such payment. In absence of the said evidence, the Employer will not process any subsequent payments to the Contractor.

**Tax Indemnity**

3.21.7 The Contractor shall indemnify and hold the Employer harmless from and against any and all liabilities, which the Employer may incur for any reason of failure by the Contractor to comply with any tax laws arising from the execution of the Contract whether during the term of the Contract or after its expiry.

3.21.8 The Contractor warrants to pay the Employer (within fourteen (14) days of demand by the Employer), an amount equal to the loss, liability or cost which the Employer determines has been (directly or indirectly) suffered by the Employer for or on account of the Contractor’s Tax liability arising from the Contract.

3.21.9 Where the amount in 3.21.8 above remains unpaid after the end of the fourteen (14) days moratorium, the Employer shall be entitled to compensation for financing charges.

### 3.22 Shipping Arrangements

**Pre-Shipment Inspection**

3.22.1 Kenyan regulations require that all imported goods be inspected prior to shipment to verify price, quality and quantity.

3.22.2 The names of the Inspection Agencies appointed by the Kenyan authorities to act under this Contract will be notified to the Contractor on the Import Declaration Form, which is obtained by the Employer. The pre-shipment inspection if positive authorizes the Contractor to ship the goods.

3.22.3 The Contractor should establish contact and liaise with the Inspection Agencies immediately upon learning of their names.
3.22.4 The cost of presentation of the Goods to the Inspection Agencies, unpacking, handling etc. shall be paid for by the Contractor.

3.22.5 The Contractor shall give at least 21 days’ notice before shipment to the Inspection Agency indicating the place where the Goods may be inspected and the expected time of shipment. When requesting pre-shipment inspection, the Contractor shall provide the Inspection Agency with a copy of the pro-forma invoice, Contract and any other document relevant to the execution of the inspection. On completion of inspection the Inspecting Agency will issue a report of finding which will be either

(a) A Clean Report of Finding if the inspection yields a satisfactory result, or

(b) A Non-negotiable Report of Findings if the inspection reveals deficiencies.

3.22.6 In the case of a Clean Report the Contractor shall provide the Inspection Agency immediately after shipment with a non-negotiable copy of the Bill of Lading or Air Waybill and a copy of the final invoice covering the Goods. When these documents have been received the Clean Report of findings will be issued. The Contractor is warned against the shipment of Goods, which have not been inspected, or goods for which a Non-negotiable Report of Findings has been issued by the Inspection Agency.

3.22.7 The inspection of Goods does not relieve the Contractor of its contractual obligations to the Employer and may reject items if they fail to meet the requirements of the Contract even though the Inspection Agency for shipment has cleared them.
SPECIAL CONDITIONS OF CONTRACT
SECTION IV: SPECIAL CONDITIONS OF CONTRACT

4.1 Special Conditions of Contract shall supplement the General Conditions of Contract. Whenever there is a conflict, between the GCC and the SCC, the provisions of the SCC herein shall prevail over these in the GCC.

4.2 Special conditions of contract as relates to the GCC

<table>
<thead>
<tr>
<th>REFERENCE OF GCC</th>
<th>SPECIAL CONDITIONS OF CONTRACT</th>
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<tbody>
<tr>
<td>3.1.1.(f)</td>
<td><strong>Commencement date:</strong> shall be date of project kick off meeting called by procuring entity after signing of contract by both parties or any other agreed upon date in writing by both parties after contract signing</td>
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<tr>
<td>3.1.1.(g)</td>
<td><strong>Contract period:</strong> Contract shall be valid for thirty (30) months from the date of commencement (This include 12 months retention period)</td>
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<td>3.7.5</td>
<td>Amount of Performance Security is 10% of the contract sum</td>
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<td>3.7.6</td>
<td>The supplier shall be required to expressly confirm that the goods supplied shall be under 24 month’s warranty.</td>
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<tr>
<td>3.10</td>
<td>Delivery period shall not exceed 12 months from the commencement date. Delivery period shall be the period from the commencement date to the date of arrival of equipment at site and acceptance by the procuring entity</td>
</tr>
<tr>
<td>3.11.2</td>
<td>Proof of Insurance shall be provided to KenGen on demand</td>
</tr>
<tr>
<td>3.12.1</td>
<td>Payment milestones shall be as follows</td>
</tr>
<tr>
<td></td>
<td>(i) 85% on delivery of all equipment to site and acceptance thereof by the procuring entity</td>
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<td></td>
<td>(ii) 10% after provision of site training and commissioning support</td>
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<td></td>
<td>(iii) 5% after retention period, 12 months after delivery</td>
</tr>
<tr>
<td>3.12.3</td>
<td>Terms of Payment shall be as follows</td>
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<tr>
<td></td>
<td>(i) Local: - EFT, Credit period 30 days</td>
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<tr>
<td></td>
<td>(ii) Letter of Credit terms for Overseas suppliers</td>
</tr>
<tr>
<td>3.18.3</td>
<td>Arbitration where necessary shall be by the Chartered Institute of Arbitrators Kenya Chapter</td>
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TECHNICAL SPECIFICATIONS
SECTION V: TECHNICAL SPECIFICATIONS

5.1 GENERAL INFORMATION AND REQUIREMENTS

5.1.1 INTRODUCTION

5.1.1.1 KenGen has an existing SCADA system used to automate and allow remote control of seven forks and Turkwel HEP plants.

5.1.1.2 Seven Forks plants are Masinga, Kamburu, Gitaru, Kindaruma and Kiambere which are along Tana River. Distance from Nairobi to the seven forks plants is between 150km for Masinga and 190km for Kiambere. Turkwel is located along river Turkwel on the boundary of West Pokot & Turkana counties approximately 550 km from Nairobi.

5.1.1.3 All the plants are served by all-weather roads (tarmac) all the way from Nairobi.

5.1.1.4 In order to improve power plant operations, KenGen has decided to replace the existing SCADA computer and networking hardware whilst reusing existing plant control systems and SCADA software.

5.1.1.5 The project scope covers: Manufacture, Testing and training at the Manufacturer’s Factory; shipping & delivery to site (DAP incoterms); of SCADA computers and networking hardware for Seven forks and Turkwel HEP power stations in Kenya. Detailed scope is covered under clause 5.1.5 and clause 5.2 of specifications.

5.1.2 DEFINITIONS

Whenever the following terms or words are used in the specifications or any other documents forming part of this tender document, they shall have the following meaning unless otherwise stated:

1. AC: means Alternating Current
2. ACB: means Air Circuit Breaker
3. ADC: means Analogue to Digital Conversion
4. AVR: Automatic voltage regulator
5. BOM: shall mean Bill of materials or list of equipment
6. CB: means circuit breaker unless otherwise stated
7. CT: means current transformer
8. DAS: -Data acquisition server-in context of this tender it shall mean SCADA computer hardware connected to plant control systems interfacing the plant systems to the SCADA system.
9. D-AVR: Digital Automatic voltage regulator
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

10. DC: means Direct Current
11. EDG: means Emergency diesel generator
12. ETU: Shall mean electronic trip units commonly used in low voltage circuit breakers
13. FAT: Factory acceptance tests
14. FIDIC - Fédération Internationale des Ingénieurs Conseils (International Federation of Consulting Engineers)
15. GCB-shall mean generator circuit breaker
16. GSU: Generator step up transformer
17. HMI- Human machine interface- In this document refers to hardware and/or software required for human user to interface to the systems supplied for control and monitoring purpose
18. HV-High Voltage: operating voltage higher than 52.5 kV
19. HVAC-Heating, ventilation and air conditioning
20. ICS – Industrial control systems
21. IED: -Intelligent electronic device: refers to programmable microprocessor based electronic devices e.g. numerical protection relays, smart relays etc. used in industrial environment for instrumentation, metering, control or protection purposes.
22. IP xx - Ingress protection: means “Degree of Protection Provided by Enclosure”. and shall be according to IEC 60529
23. IT – Information technology
24. LAN-Local Area Network
25. LCC: Local control centre
26. RCC: Remote or regional control centre
27. LV-Low Voltage: operating voltage below 1000V. (For transformers, the term Low Voltage Winding is used for the side with lowest rated voltage regardless value)
28. MCCB: means Moulded case circuit breaker
29. MPCB-Motor protection circuit breaker
30. MCB: means Miniature circuit breaker
31. MV-Medium Voltage: operating voltage higher than 1000 V and up to 52.5 kV.
32. NAS-Network attached storage
33. NC-Normally closed
34. NO-Normally open
35. NSTA- National Standards and Testing Authority
Ten
der for supply of SCADA hardware for seven forks & Turkwel hydroelectric power
plants

36. OEM-Original Equipment manufacturer
37. OLTC-On Load Tap Changer
38. OPC- Open Platform Communications (OLE for process control)-shall
 imply the widely-accepted communication platform for real-time plant
data exchange between control devices from different manufacturers
39. OPC UA -OPC Unified architecture
40. OPC DA – OPC Data access
41. OT – Operations technology- hardware and software systems that
 monitor and control physical equipment and processes. i.e ICS systems
42. PC- Personal computer: Refers to IBM PC compatible computers i.e. intel
 X86/X64 based personal computers running windows operating system
43. PIMS-Plant information management system
44. PLC-shall mean Programmable Logic Controller unless otherwise defined
 in the document
45. POSE: Physical operating system environment
46. SAS: Substation Automation System
47. SAT: Site acceptance tests
48. SCADA: -shall mean Supervisory control and data acquisition system.
 Client/KenGen SCADA shall mean the existing SCADA at the power
 plants operated by the client
49. SDG-SCADA data gateway-multi protocol converter for SCADA
 communication protocols
50. SLD: - shall mean single line diagram
51. SOE: - Sequence of events
52. SPST-Single pole single throw
53. SPDT-Single pole double throw
54. Station/plant-These words shall predominantly refer to a power station
 i.e. Turkwel, Masinga, Kamburu, Gitaru, Kindaruma, Kiambere etc. in
 the tender unless implied otherwise by the sentence
55. System- Could mean a physical (hardware) system or a software system
56. Unit-Shall in many occasions in this document refer to complete
 generation unit composed of Turbine, generator, GSU transformer,
 control system and balance electrical and mechanical system. unless
 implied otherwise by the sentence
57. VM: Virtual machine
58. VOSE: Virtual operating system environment
59. VT: means voltage transformer
5.1.3 GENERAL MANDATORY REQUIREMENTS

5.1.3.1 These specifications describe the requirements for goods and services to be procured by the procuring entity. Tenderers are requested to submit with their offers the detailed specifications, drawings, catalogues, etc for the products they intend to supply.

5.1.3.2 Tenderers must indicate on the Technical schedules whether the equipment offered comply with each specified requirement.

5.1.3.3 All the dimensions and capacities of the equipment to be supplied shall not be less than those required in these specifications. Deviations from the basic requirements, if any shall be explained in detail in writing with the offer, with supporting data such as calculation sheets, etc. The procuring entity reserves the right to reject the products, if such deviations shall be found critical to the use and operation of the products.

5.1.3.4 The tenderers are requested to present information along with their offer’s information on proper representative and/or workshop for back-up service/repair and maintenance including their names and addresses.

5.1.3.5 All documents to be submitted shall be in ENGLISH language ONLY. The SI-system (meter, Newton, second) shall be used throughout the documentation covered by this Specification.

5.1.3.6 Systems specified in this tender and all associated systems shall be designed to ensure continuity of operation under all working conditions and to facilitate inspection, maintenance and repairs. All reasonable precautions shall be taken in the design of equipment to ensure safety of personnel concerned with the operation and maintenance of the equipment.

5.1.3.7 All components shall be adequately rated or sized for their most onerous duty at the specified environmental conditions. Due account shall be taken of any heat generated by the equipment therein and the components shall be appropriately selected, rated or de-rated as necessary to suit the most onerous operating temperature within the equipment.

5.1.3.8 All Works shall comply with the technical guarantee data stated in the specifications. The Contractor shall be responsible for any discrepancies, errors and omissions in the particulars and guarantees.

5.1.3.9 All apparatus, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of the finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall
be complete in all details, whether or not such details are mentioned in the Specifications.

5.1.3.10 Any reference in the quantity and price schedules, the delivery period schedule or in the various clauses and schedules of the text of either the Specification or the Bid, to any equipment shall imply equipment that is complete with all accessories, apparatus and fittings as outlined.

5.1.3.11 All materials and skilled labour, whether of temporary or permanent nature, required by the Contractor for the design, manufacture, delivery to site of the equipment shall be supplied and paid for by the Contractor.

5.1.3.12 If in conflict, the ranking of documents in the technical specifications, in decreasing priority, is as follows:

(a) Particular technical specifications
(b) Scope of supply
(c) General technical specifications
(d) General specifications
(e) Technical schedules
(f) Specification drawings
(g) Preliminary bill of materials
(h) Standards

5.1.3.13 If the Tenderer is of the opinion that there is conflict or disagreement between the particulars of the documents, standards etc. it must be clearly stated in the tenderer Bid offer document, failure to which, the materials and equipment offered shall be deemed to comply in every respect with the current Specification both in manufacture and in performance, and compliance thereof shall be insisted upon without additional cost to the procuring entity.

5.1.3.14 Specifications given in general technical requirements shall apply to all Equipment specified in the particular specifications. The equipment, devices etc. whose specifications have been provided in general technical specifications shall be used in the subsections of the project specified by each particular specification. If there is a conflict between general technical specifications and particular technical specifications the latter shall prevail. Not all equipment specified in the general technical specifications are in scope of supply.

5.1.3.15 The bidder shall visit the site and get acquainted with the actual requirements of site prior to quoting rates. No claims for inadequate description of the scope shall be entertained at a later date.

5.1.3.16 Deviations to this specification SHALL NOT be acceptable unless specifically indicated in the offer in the relevant schedule “deviation from technical specifications form”. All
deviations shall be clearly spelt out by the Bidder. Any implied deviation or any deviation mentioned elsewhere in the offer shall not be considered.

5.1.3.17 It is not the intent of this specification to completely specify all details of design and construction herein. Nevertheless, the equipment and installation shall conform to high standards of engineering design and workmanship in all respects and shall be capable of performing continuous operation in a manner acceptable to the client. Reliability, availability and maintainability are of the utmost importance to the client in the design of the equipment described herein.

5.1.4 TENDER BID DOCUMENTATION BY TENDERER

5.1.4.1 General requirements

5.1.4.1.1 Tender bid documentation will guide the client during the tender evaluation. Documents shall clearly demonstrate the bidders' offer compliance to technical specifications.

5.1.4.1.2 The following Documents shall be provided by the bidder:

(a) Bidders technical proposal (in hard copy & soft copy) composed of
   (i) Project Implementation plan
   (ii) Preliminary bill of materials
   (iii) Technical schedules
   (iv) Deviations form technical specifications if applicable
   (v) List of referenced manuals, technical data sheets, manufacturer catalogues etc

(b) OEM technical manuals (in soft copy only)

(c) Technical data sheets, manufacture catalogues etc (in soft copy only)

(d) Type test reports as detailed in particular specifications (in hard copy & soft copy)

(e) Product certifications as detailed in particular specifications (in hard copy & soft copy)

5.1.4.1.3 All manuals, data sheets and catalogues provided MUST be listed in the Reference list of manuals, datasheets and catalogues forming part of bidders’ technical proposal as detailed in clause 5.1.4.2 for them to be considered to have been submitted.
5.1.4.1.4 Where a submitted catalogue, manual or datasheet contains more than one model of the device the bidders shall circle or highlight the model they are offering.

5.1.4.1.5 As a minimum, the bidder shall furnish the technical proposal in hard cover bound sets failing to which the bids shall be rejected. Soft copy of the documents shall also be handed over in a CD/DVD/memory drive. Manuals, catalogue and data sheets to be provided in soft copies

5.1.4.1.6 In the event of any difference between the Drawings and the Specifications stated, the latter shall prevail. In the event of any difference between scaled dimensions and figures on the drawings, the figures shall prevail.

5.1.4.2 Bidders’ Technical Proposal

5.1.4.2.1 A proposal containing information elaborate enough to enable the employer to comprehend and assess the vital details, features, capabilities and functioning of the equipment offered and their arrangements shall be included in the bid offer.

5.1.4.2.2 Bidders’ technical proposal shall offer a clear response to the employers’ specifications.

5.1.4.2.3 Technical proposal shall be provided in **hard and soft copies**

5.1.4.2.4 It shall clearly demonstrate the complete scope of work as defined by the specification and **MUST** include, but not be limited, to the followings:

   (a) **Implementation program** in Gant chart format. The Gant chart shall illustrate a comprehensive [summary] work programme, showing all the activities and duration required, from tender award stage to delivery of the equipment in chronological order. ALL project activities and duration **MUST** be clearly illustrated, the activities include:

   (i) Design and design review/approval by client

   (ii) Provision of technical documentation

   (iii) Manufacture

   (iv) Factory training

   (v) Factory Inspection and acceptance testing, FAT

   (vi) Packing, transportation, Offloading and placement.

   (vii) Site training

   (viii) Commissioning support

   (ix) Online support
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

(b) **Preliminary Bill of materials (BOM)** dully filled and Bidder’s scope of supply if not fully covered by the provided preliminary bill of materials.

(c) **Technical schedules** dully filled

(d) **Deviation from technical specifications schedule** dully filled if applicable

(e) **Reference list of manuals, datasheets and catalogues**—a list of all manuals and technical data sheets provided by the bidder in softcopy shall be provided. The list shall contain the following information in columns

(i) Equipment/device name

(ii) File name of manual/data sheet of the soft copy provided

(iii) Web address where the file can be accessed—where possible

(iv) File access path if they are several folders and subfolders in the soft copies submitted e.g. (Vol2/networking/“Switch manual)

5.1.4.3 **OEM Technical manuals**

5.1.4.3.1 Comprehensive OEM Technical manual shall be provided for

(i) Industrial PC

(ii) Industrial ethernet Switches

(iii) Industrial PTP grandmaster clock and time server

5.1.4.3.2 Each Manual shall as a minimum, cover the following topics:

(i) Detailed description of equipment, including at minimum: the structural description and dimensions, functional descriptions with block diagrams, characteristic curves and logic diagrams, General assembly drawings, control and wiring diagrams, operating conditions, operation description, etc.

(ii) Equipment rating: power, insulation, voltage, current, temperature, flow, fault withstand, breaking capacity, various operating characteristic curves, relevant clearances, tolerances, operating temperature etc.

(iii) Range of features to be provided.

(iv) Range of optional features not provided.

(v) Range of settings provided for all features, both offered and optional.

(vi) Operation and maintenance

(vii) Statement of performance under reference conditions.

(viii) Effects of interruptions to dc auxiliary power supply.

(ix) Standards the equipment complies to

5.1.4.3.3 All Manuals to be provided in soft copies
5.1.4.3.4 All manuals provided MUST be listed in the Reference list of manuals, datasheets and catalogues forming part of bidders’ technical proposal as detailed in clause 5.1.4.1. for them to be considered to have been submitted.

5.1.4.4 Technical data sheets

5.1.4.4.1 Technical data sheets and or catalogues briefly describing: technical specifications; rated values; operating conditions; physical dimensions, standards of manufacture and testing, photo illustration of the equipment etc. shall be provided.

5.1.4.4.2 Datasheets/catalogues shall contain information to support all technical specifications of equipment offered by the bidder

5.1.4.4.3 The equipment/item offered shall be clearly marked in the datasheet/catalogue

5.1.4.4.4 Data sheets and catalogue to be provided in soft copies

5.1.4.4.5 Datasheets and catalogues shall be provided for but not limited to each of the following:

1. Rack mount Industrial PC
2. Rack mount Industrial ethernet Switches
3. Rack mount Industrial PTP grandmaster clock and time server
4. Panel touch screen Industrial PC
5. Rack mount enterprise host Servers
6. Rack mount enterprise NAS Servers
7. Rack mount enterprise Workstations
8. Rack mount enterprise Security Appliances/gateway
9. Industrial grade security appliance/gateway
10. Thin client PC
11. Cisco ethernet switches
12. Desktop two port dual display KVM switches
13. Panel/DIN mount four port KVM switches
14. Rack mount LCD, keyboard & KVM switch console for RCC panels
15. Rack mount console keyboard for LCC panels
16. Panel mount Industrial grade touch monitor for LCC panels
17. Desktop LED/LCD Monitor
18. Digital power & energy meters
19. DCF77 Time code output converter
20. Any other device stated in the bidder’s offer
5.1.5 PROJECT SCOPE

5.1.5.1.1 The scope of supply shall cover the following
(a) Two SCADA RCC server cabinets (Kamburu plant only),
(b) SCADA LCC panels (one per plant)
(c) Workstation terminals (all plants)
(d) Process LAN panels (one per plant)
(e) PLC panel devices delivered as loose items (all plants)
(f) Tools and accessories
(g) Spares
(h) Software pre-installed into the supplied hardware.

5.1.5.1.2 In fulfilment of the above, the contractor shall carry out the following activities but not limited to:
(a) Manufacture,
(b) Factory acceptance testing and training at the Manufacturer’s Factory;
(c) Packing for transport; insuring; shipping & delivering to the port of Kenya;
(d) Customs clearing;
(e) Local Transportation, insuring, delivery to Site,
(f) Site training
(g) Commissioning support
(h) Online support
(i) Technical documentation provision and
(j) Warranty

5.1.6 PROJECT WORK PROGRAM

5.1.6.1 Work program shall be detailed to cover all project activities to be carried out.
5.1.6.1.1 After the tender award, the approved tenderer shall prepare a draft implementation plan covering the design, manufacture, testing delivery, training and commissioning support, in sufficient detail. The implementation plan shall be prepared in the form of a Critical Path Method Network and a Gantt chart.

5.1.6.1.2 After tender award and prior to contract signing the client and Approved tenderer shall meet, discuss and review the draft work program, the contractor shall subsequently prepare a final work program for client approval.
After contract signing, a kick off meeting shall be held at the procuring entity premises to discuss the following:

(a) Observe in detail the existing equipment
(b) Final equipment design
(c) Drawings and drawings approval
(d) Server virtualisation and cyber security implementation strategies
(e) Project implementation program
(f) Factory acceptance testing and training
(g) Commissioning support
(h) Any other pertinent project issue

The total delivery period shall not exceed **12 months**; the duration shall be time period from commencement to final delivery and acceptance at site or as otherwise defined in the conditions of contract

**5.1.7 DOCUMENTATION**

**5.1.7.1 General Mandatory Requirements**

5.1.7.1.1 The Contractor shall prepare and submit to the Project Engineer for approval dimensioned general and detailed design drawings and other pertinent information of all the Plant and equipment specified in the tender documents.

5.1.7.1.2 Approval of drawings shall not relieve the Contractor of his obligations to supply the Plant in accordance with the Specifications. The Contractor is responsible for any errors that may appear in the approved documents. He shall as soon as an error has been detected, deliver the corrected documents to the Project Engineer for re-approval.

5.1.7.1.3 All text on documents provided by the Contractor shall be in the United Kingdom ENGLISH LANGUAGE ONLY. Technical Documentation written in any other language SHALL BE REJECTED and presumed not to have been submitted.

5.1.7.1.4 All drawings and documents shall be dimensioned in millimetres

5.1.7.1.5 The Contractor shall, during the total project time, maintain a List of Documentation to be updated by him whenever needed. The List of Documentation shall include the date of original issue of each document submitted as well as the dates of every revision. The List of Documentation shall also include a time schedule for the submittal of the documentation.

5.1.7.1.6 Symbols used for electrical equipment and components shall be in accordance with IEC 60617. The Contractor shall establish a coherent system for physical and functional reference designation in accordance with IEC81346. A similar
systematic scheme shall be defined for cable numeration. These schemes shall be used throughout on the drawings and documentation and the designation shall be labelled on the components and cables. Auxiliary relays shall be assigned alphanumeric device numbers in the drawings where the numeric part shall be as per IEEE C37.2-2008 (e.g. K51 for overcurrent auxiliary relay)

5.1.7.1.7 In addition to what is stated elsewhere in the tender, the following shall apply to all technical documentation handed over to the client after the project:

(a) The sizes of all documents and drawings shall conform to the ISO standard, i.e.: A1 (594mm x 841mm), A2 (420mm x 594mm), A3 (297mm x 420mm) & A4 (210mm x 297mm)

(b) Scales to be used on the drawings shall be 1:10, 1:20, 1:40, 1:50 and multiples of this series.

(c) All drawings shall be dimensioned in millimetres

(d) Technical documentation e.g. manuals, test reports, list of materials, cable lists i.e. all technical documents including ALL drawings shall be provided in A4. Schematic diagrams shall be provided in both A4 and A3. Structural & mechanical drawings shall be provided in A4, A3 and A2/A1 (depending on drawing size).

(e) All drawings made special for this project shall be compiled on a computer aided drawing system and as part of the as built documentation be handed over on a CD with a format readable in latest version of AutoCAD and in any another editable format to be agreed upon and pdf in addition to the paper copies.

5.1.7.1.8 All drawings and technical documentation shall be bound in hard covers as per sample to be provided. NO document shall be folded to fit the book binding, the Binding covers shall be sized according to the containing documents i.e. there shall be A4, A3, and A2/A1 binding covers. Documents of different sizes SHALL NOT be bound together on the same cover. The number of pages per bound volume shall not exceed two hundred (200)

5.1.7.1.9 Any illegible copies of documentation submitted shall be rejected by the employer.

5.1.7.1.10 The SI-system (meter, Newton, gram second) shall be used throughout the works and documentation.

5.1.7.1.11 The Employer’s technical specification drawings attached to the Bid Documents are of informative character. These drawings are intended to illustrate the basic requirements to be satisfied. It is the responsibility of the contractor to prepare a detailed layout/schematic for the new system
5.1.7.2 **Technical Documentation**

5.1.7.2.1 Technical documentation shall consist of but not limited to: -

(a) Technical manuals
(b) Bill of materials,
(c) All technical drawings i.e. schematic, wiring, panel layout drawings, mechanical & structural assembly drawings.
(d) Wiring schedules i.e. cable schedules and terminal diagrams
(e) Functional design specifications and calculations
(f) Device setting/parameter configurations
(g) Project progress reports
(h) FAT plans/program
(i) Training programs and materials
(j) FAT reports
(k) Type test reports for all supplied equipment

5.1.7.2.2 Technical manuals shall contain: -

(a) System description consisting of: Introduction/overview of components, functional description, overall Equipment operating philosophy and operating conditions.
(b) System/equipment rating: power, insulation, voltage, current, temperature, flow, fault withstand, various operating characteristic curves, relevant clearances, tolerances, operating temperature etc.
(c) Equipment overall design and specific detailed features of design including: Design calculations, descriptive drawings, schematic diagrams, layout diagrams, block diagrams, list of internal materials, connection and terminal list, equipment and components dimensional drawing and control diagram.
(d) Installation and assembly instructions
(e) Complete operating instructions: included shall be precautions and critical points to be observed, including suggested form to be used in taking periodic readings to maintain an operations record. There shall be a tabulation of possible operating difficulties with the probable causes listed and remedial action to be undertaken for each one. Emergency procedures
(f) Manufacturer catalogues and technical data sheets for all components and devices.
(g) Software Manuals for ALL software provided including manuals for Programs and application created for this project e.g. Logic diagrams, HMI
application etc. Software manuals to detail: how to use the software, install and un install, license key, support, upgrading & updating, system requirements, troubleshooting etc.

(h) Detailed instructions for programming settings and configuration of all software configurable devices. Instructions for downloading, uploading and backing up settings & configurations,

(i) Complete instructions for ordering replacement parts in a manner that would prevent errors or misunderstanding. Recommended forms for tabulating replacement part information and instructions for returning materials to the factory shall be included.

(j) Maintenance instructions manuals split into:
   (i) Manuals for preventive maintenance indicating periodic inspections, tests, cleaning, lubrication and other routine maintenance. A clear concise document with CHECKLISTS detailing tests and inspections to be done after duration of time e.g. monthly, annual etc.
   (ii) Trouble shooting manual listing all possible failure and their remedy
   (iii) Repair manuals describing fault location, dismantling, re-assembly etc.

5.1.7.2.3 Four sets of manuals shall be provided.
5.1.7.2.4 All technical Drawings shall be part of technical documentation.
5.1.7.2.5 Bill of materials as minimum shall contain device, equipment or material: designation or name, model no., quantity, manufacturer, and description. i.e. basic ratings, no. of inputs & outputs of each type, provided functions/features, optional functions/features not provided, no. of contacts etc.
5.1.7.2.6 Factory test report (FAT) shall be the duly filled approved test plan with at least the following: plotted design characteristic curves, test result characteristic curves, Equipment set points for various parameters during testing e.g. pick up values, alarm and trips etc., tabulated results of all tests carried out etc.
5.1.7.2.7 The documentation shall leave the operators and maintenance personnel in position to operate the plant in a safe and optimal way and to perform repairs, upgrades and rehabilitation usual to be done by such personnel.
5.1.7.2.8 The Project Engineer shall approve all technical documents before final submission.

5.1.7.3 Drawings Requirements

5.1.7.3.1 engineering drawings shall include the following types of drawings: schematics, single line diagrams, layout, structural, mechanical, wiring, logic diagrams,
5.1.7.3.2 Before starting manufacture of the equipment, dimensioned drawings showing all the equipment and components details, detailed schematic, structural and layout diagrams and detailed data of all the equipment and materials to be used shall be submitted to the Client for approval.

5.1.7.3.3 Drawings shall have a KenGen identification number structured as below.

(a) KGN-GIT-TUR-XXXX – Turbine and associated systems e.g. governor, turbine instruments etc.
(b) KGN-GIT-GEN-XXXX – Generator and associated systems i.e. excitation, generator instruments etc.
(c) KGN-GIT-CAX-XXXX – Common auxiliaries e.g. low voltage switchboards, common DC distribution, battery chargers etc
(d) KGN-GIT-SBS-XXXX – Substation equipment e.g. generator MV switchgear, step up transformers, HV switchgear etc
(e) KGN-GIT-PROT-XXXX – Protection equipment e.g. Protection IED etc
(f) KGN-GIT-UCB-XXXX – Unit control boards e.g. unit control PLC, Unit MCC, manual control panel, synchronizing equipment etc.
(g) KGN-GIT-MET-XXXX – Revenue metering equipment
(h) KGN-GIT-SCD-XXXX – SCADA equipment e.g. servers, network & telecom, HMI systems etc.
(i) Where XXXX shall be, a numeric number. This shall be further discussed and agreed on during the preliminary design.

5.1.7.3.4 In addition to the information provided on drawings, each drawing shall carry a revision number, date of revision and brief details of revision or designer notes wherever any revision is carried out, correspondingly revision number must be updated. All revisions carried out (not initiated by the client) shall be highlighted on the drawing and a Separate sheet furnished stating the reasons for such revision. A note stating drawing is generally revised is not acceptable.

5.1.7.3.5 These drawings shall be submitted within the times mentioned here under from the Date of tender award. Time shall be allowed to permit changes to be made if required by the Client. The drawings shall be modified as necessary if requested by the Client, and resubmitted for final approval.

5.1.7.3.6 After approval of drawings by the Client, the Contractor shall supply the approved drawings to the Client, as indicated below.

(a) Drawings for approval 1 Copy
(b) Approved drawings 1 Copy
5.1.7.4 Document Approvals

5.1.7.4.1 During project execution, technical documents shall be approved by the client as per provision of this clause (5.1.7.4). This shall apply to all technical documents, however; the documents below shall follow all the process described this clause (5.1.7.4):

(a) All drawings i.e. structural, layout, schematic, logic diagrams, wiring schedules, device lists etc.
(b) Bill of materials
(c) Functional design specifications & design calculations
(d) Device setting/parameter configurations

5.1.7.4.2 The Contractor shall provide the following documents within the first month after the contract commencement for approval.

(a) Work program containing Method statements and implementation program
(b) Bill of materials
(c) Training program and syllabus

5.1.7.4.3 Detailed schematic, structural and layout drawings shall then be submitted after approval of the above preliminary documents.

5.1.7.4.4 When the Contractor prepares their work program, as required herein, they shall make allowance for document approval time and indicate it on the program. Claims or extensions of time will not be approved if they are related to the late submission of drawings to the Client or if they involve delays caused by drawings not being approved by the Client.

5.1.7.4.5 During the design stage, the contractor shall send documents/drawings to the client for approval and comments. A copy of each document will be returned to the Contractor marked “Approved”, or “Approved as noted”, or “Not Approved”.

5.1.7.4.6 Documents submitted by the contractor for approval will be checked / reviewed by the employer and comments, if any, on the same will be conveyed to the contractor. It is the responsibility of the contractor to incorporate correctly all the comments conveyed by the Employer on the Contractor’s documents & drawings. If the Contractor is unable to incorporate certain comments in their design, they shall clearly state in their forwarding letter such non-compliance along with valid reasons and justification.

5.1.7.4.7 Comment of “not approved” would imply the drawing/document must be re-done as per comments given; meaning the client is not in agreement with the content, idea and implications of the drawing/document on the overall design
and operation of the system. Comment of “approved as noted” shall imply the client agrees with the idea or implications of the drawing/document but requires some changes to be implemented before approval.

5.1.7.4.8 Documents with comments of “Approved as noted”, or “Not Approved” shall be reviewed by the contractor as per given comments and resubmitted to the employer for approval. The employer will review the resubmitted document as described in the previous clause. The process shall be repeated until all the submitted documents are approved.

5.1.7.4.9 Documents requiring revision shall be promptly dealt with and resubmitted as aforementioned. Thereafter, changes shall NOT be made in the Contractor’s drawing without written permission of the project Engineer. The above procedure shall be repeated for all authorized changes. It is to be understood, however, that approval of the drawings shall not relieve the Contractor of any responsibility in connection with the work.

5.1.7.4.10 All documents submitted for approval or sent to the Client for any other reason may be sent by courier or e-mail.

5.1.7.4.11 Any work performed or material ordered by the contractor prior to receipt of drawings stamped ‘Approved’ by the employer shall be at the risk of the contractor. After print of any drawing has been returned ‘Approved’, the contractor may release the parts covered by the drawing, for production / construction.

5.1.7.4.12 All drawings and data supplied by the Contractor subsequent to the date of contract, which cover changes in the work, extra work, or which supplement existing drawings and data shall, upon approval by the Client Engineer, form part of the contract documents.

5.1.7.4.13 If, at any time before the completion of the work, changes are made necessitating revision of approved drawings/document, the contractor shall make such revisions and proceed in the same routine as for the original approval.

5.1.7.4.14 To expedite the delivery and return of the required drawings, scanned drawings shall be used and sent to the following KenGen E-mail addresses–

imuoka@kengen.co.ke

C.c:-

pkiambuthi@kengen.co.ke
dwangariria@kengen.co.ke

Or any other email supplied by the client.
### 5.1.7.4.15 Equipment manufacture and assembly

Equipment manufacture and assembly shall be in accordance with the approved drawings and data and shall not commence until such approval has been obtained. Subsequent changes contemplated by the Contractor shall be indicated on revised drawings and data resubmitted for approval. The Contractor shall make any changes in the design which are considered necessary to make the work conform to the provisions and intent of the specification without additional cost to KenGen.

### 5.1.7.4.16 Approval of the Contractor’s drawings and data

Approval of the Contractor’s drawings and data shall in no way construe or imply relief of the Contractor from responsibility for any error or omission therein or from any obligation under the Contract.

### 5.1.7.4.17 Final approval of documents

After final approval of documents, the contractor shall send to the client all the documents listed in **clause 5.1.7.4.1** stamped/or indicated as “factory as built”. These shall be used for factory acceptance tests and FAT report.

### 5.1.7.5 Final Documentation

5.1.7.5.1 After all items of the equipment have been manufactured and delivered; complete sets of prints and softcopies of the technical documentation for all new systems shall be furnished as indicated below.

| (a) Soft copies of ALL as built drawings in AutoCAD electrical 2018 format |
| (b) Four Complete sets of bound prints for ALL technical documentation detailed in clause 5.1.7.2 in A4 size |
| (c) Four Complete sets of bound prints for ALL as built SCHEMATIC drawings in A3 ONLY |
| (d) Four Complete sets of bound prints for all as built structural and mechanical drawings in A3 and A2/A1. |
| (e) Soft copies of ALL Logic diagrams and software applications in original software format and the software with a licence, used to create the logic diagrams/programs |

### 5.1.8 MANUFACTURING AND SHIPMENT

#### 5.1.8.1 Quality Assurance Plan:

5.1.8.1.1 The bidder shall invariably furnish along with his offer the quality assurance plan adopted by their sub-supplies in the process of manufacturing all major equipment/component.
5.1.8.1.2 Precaution taken for ensuring usage of quality raw materials and sub-components shall be stated in the quality assurance plan.

5.1.8.1.3 The bidder should specifically express their consent to accept additions, revisions to their quality assurance plan to meet the employer’s requirements if needed. The final quality assurance plan to be adopted, with mutual consent, shall be decided after discussion with successful bidder.

5.1.8.2 Places of Manufacture and Sub-Contractors

5.1.8.2.1 All equipment offered should be the product of recognised and experienced manufacturers who have been manufacturing specified equipment for the last twenty years. Equipment shall be of basic design and size similar to such that has been in successful continuous operation for at least three years preferably under similar climatic conditions. Proven plant reliability and high availability are of prime importance and the attention of the tenderer is drawn to these particular requirements.

5.1.8.2.2 The manufacturer's identity and places of manufacture, testing and inspection before shipment for the various portions of the Contract Works shall be specified in the Technical Schedules and shall not be departed from without the agreement of the Project Engineer.

5.1.8.2.3 As soon as practicable after entering into the Contract, the Contractor shall, having obtained the Project Manager's consent in accordance with the Conditions of Contract, enter into the Sub-contracts he considers necessary for the satisfactory completion of the Contract Works.

5.1.8.2.4 All Sub-contractors and Sub-suppliers of components and materials shall be subject to the approval of the Project Engineer. Information shall be given on each Suborder sufficient to identify the material or equipment to which the sub-order relates, stating that the material is subject to inspection by the Project Manager before dispatch.

5.1.8.2.5 If the Employer at any stage in the design and production period finds out that the sub-contractor does not fulfil the requirements in the specifications and it is obvious that the required quality cannot be achieved by corrective measure, he can request the subcontract to be suspended and the works to be produced elsewhere without extra cost for the Employer.

5.1.8.3 Inspection and Testing
5.1.8.3.1 Tendering requirements

(a) The manufacturer shall be responsible for performing or for having performed all the required tests specified under the specifications. Tenderer shall confirm the manufacturer’s capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.

(b) Full details of type tests performed on equipment identical to that being offered shall be submitted with the offer, accompanied by a proposed schedule of tests to be performed for each item of equipment.

(c) Type test reports & certificates submitted for tender evaluation shall be as detailed in clause 5.4.10.1

(d) In general, type test results shall show that the equipment being proposed for this Contract shall perform in accordance with its design specification in the environments to which it will be subject in its application on this Contract. The environmental factors include climatic (temperature, humidity, wind, rain etc.), electromagnetic (radiated and conducted), mechanical (transport vibration, handling knocks, earthquake stresses) and chemical (salt laden atmosphere).

(e) Where appropriate, the type tests should also demonstrate that the equipment does not exceed accepted standards in terms of its impact on its environment (noise, mains harmonics etc.).

5.1.8.3.2 Manufacturing quality control, inspection and testing procedures

(a) All materials used in the Contract Works are subject to inspection by the Project Engineer and it is the Contractor’s responsibility to advise the Project Engineer when equipment and materials are available for inspection, at least one month in advance. Factory tests on equipment shall be made according to the applicable IEC Standards, or as specifically specified or according to standards approved by the Project Engineer. Routine tests shall be made on each unit of all equipment.

(b) Type tests shall be made on one unit of each type of different equipment components. Instead of carrying out the type tests the Contractor may submit suitable certificates of tests made on equipment components of the same type; however, the employer reserves the right of accepting these certificates or to reject them partially or totally. Routine tests shall however be conducted on all assembled equipment; type tests reports will only be allowed as substitute for some components of the completed equipment.
(c) Measuring and test equipment to be used shall be approved by the Project Manager and if required shall be calibrated at the expense of the Contractor at an approved laboratory

5.1.8.3.3 **Factory Inspection, testing and training program**

(a) The Contractor shall prepare test procedures and result sheets for all tests. He shall also prepare a cross reference listing to show that all of the requirements of the Functional Design Specification have been included in the tests. The Contractor shall prepare and execute a testing program which will establish that specified requirements have been met and that the items furnished and installed will perform as specified and required.

(b) The Contractor shall submit to the Client for approval, during or immediately following the submission of drawings, testing plan/programs describing each test to be performed during factory acceptance tests (FAT), site commissioning and performance tests. The program shall establish the sequence of the tests, the equipment preparation and operation procedures to be followed and the **DETAILED PROCEDURE** for conducting each test.

(c) Inspection and test plans (program) may be of any form to suit the Contractor's system, but shall as a minimum:

   (i) Contain all tests specified in the particular specifications and all test requirement of the standard stated in the specifications.
   (ii) Detail inspections in form of check lists to be carried out before testing.
   (iii) Indicate where subcontract services will be employed
   (iv) Identify the characteristics to be inspected, examined, and tested at each point
   (v) Give detailed procedures, acceptance criteria to be used and the applicable verifying document. Indicate basis of the acceptance criteria i.e. standard or specification applicable.
   (vi) Indicate mandatory hold points established by the Project Engineer that require verification of selected characteristics of an item of process before this work can proceed.
   (vii) Define or refer to sampling plans if proposed and where they will be used. Where applicable, specify where lots or batches will be used.
   (viii) Duration required for each test and all tests for each system
(d) The program shall also contain performance guarantees, design values, technical particulars, or other criteria for the evaluation of each test. These programs shall be submitted for approval and distributed in the same manner as the drawings.

(e) Contractor shall submit a Factory training programme as per requirements given in scope of supply and particular technical specifications. All training topics specified in the specifications shall be covered. The program and syllabus shall be approved by client engineer in similar manner to drawings prior to the FAT. The minimum duration shall be as specified however the contractor give the necessary time required to cover the training course successfully and include in the bid.

5.1.8.3.4 Attendance of Client’s Personnel at Factory Tests and Training

(a) The Contractor shall arrange for five (5) Client’s engineers or staff members to witness tests of major items of equipment at the Contractor manufacturing plant/s.

(b) Tests for Industrial PC’s, industrial ethernet switches and the industrial time servers/clock shall be carried out at the factory where these devices are manufactured for a minimum of seven (7) days.

(c) The Contractor shall submit factory training and factory acceptance tests schedule for approval. After approval by the Client, the Contractor shall invite the Client’s engineers for training and factory acceptance tests. A period of at least one month shall be provided from date of invitation to the date of departure to the contractor’s country of manufacture to allow enough time for travelling preparations.

(d) Training at manufacturer’s plant or a reputable training centre preferably one run by manufacturer in the country of manufacture shall be provided, in order to enable client engineers, understand the equipment design, operate and maintain the equipment successfully. Factory acceptance testing shall proceed after the training.

(e) The above two tasks shall be arranged to follow each other; training to precede the factory acceptance tests.

(f) Contractor shall be responsible for all travel within country of manufacture and all other associated costs of stay by client engineers other than accommodation and out of pocket expenses which will be catered by the procuring entity. Necessary expenses including internal air ticket cost between Contractor’s manufacturing facilities, inland travel charges in the
Contractor’s country shall be included in the Tender. Where manufacturing facilities are located in different countries the contractor shall bear the cost of international travel and visa application between contractor’s main factory home country and the other countries.

(g) The procuring entity will be responsible for the round-trip airfares between Kenya and the Contractor’s main factory country, accommodation and out of pocket expenses.

(h) Contractor shall facilitate visa application for the client engineers by providing necessary support documents required by the contractors’/manufacturer’s country government.

5.1.8.3.5 FAT

(a) Prior to commencement of the tests, the equipment shall be inspected to ensure:

(i) Correct standards of workmanship and quality

(ii) Correct identification labels, cabling, tagging, housing and mounting etc.

(iii) Adequate accessibility

(iv) Compliance with the Specification and reviewed drawings (including compliance with fire safety and materials requirements)

(v) Verification of model numbers, quantities of items etc.

(b) All factory tests and training requirements detailed in the approved factory acceptance test plan/program and factory training program shall be carried out.

(c) Valid calibration certificates from a third-party accredited laboratory for test equipment to be used during FAT shall be presented to the client engineers prior to the beginning of the FAT. Only test equipment with valid calibration certificates from a third-party laboratory credited by NSTA shall be used.

(d) Conduct of the Tests

(i) The Contractor shall conduct the tests in accordance with the approved test procedures and shall enter the results in the approved result sheets.

(ii) For each test, the Employer will determine whether the test has passed or failed. In general, the test will be considered to have failed if either:

    ✓ The result of the test is not in accordance with the expected result described in the test procedure, or
The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the Employer considers to be a fault.

(iii) Full use shall be made during the tests of operator manuals and other documentation provided by the Contractor to determine the accuracy of the tests.

(e) Failures

(i) The Contractor shall correct all faults found during testing, and shall arrange for the test to be repeated. The test shall only be repeated when the fault has been remedied and the equipment demonstrated to function correctly.

(ii) Where remedial measures involve significant modifications that might, in the Employer’s opinion, affect the validity of earlier tests then the Contractor shall repeat the earlier tests and obtain satisfactory results before repeating the test in which the fault was first identified.

(iii) The Employer shall have the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract requirements, without in any way prejudicing his rights under the contract.

(iv) The Employer shall have the right to suspend any test in the event that errors or failures have become unacceptable. The Employer shall also have the right to suspend any test in the event of a fault being detected by the Contractor but not reported to the Employer within 24 hours. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the Employer.

(f) Repeat Tests

(i) The Contractor shall correct and re-test every fault detected during the tests.

(ii) Time spent by the Employer witnessing re-tests, or waiting at the Contractor’s premises or the test site while corrections are made prior to re-test, shall be charged to the Contractor at the standard hourly rate for the personnel concerned.
(iii) All other costs incurred by the Employer as a result of such re-tests, including accommodation, subsistence and travel charges, will be charged to the Contractor at cost. If the Employer is required to return to the Contractor's premises or the test site to witness such re-tests then time spent by the personnel concerned in travelling to the site of and witnessing such re-tests, and all charges incurred by them in so doing, including travel and accommodation shall be charged to the Contractor.

(g) After the tests, detailed test report and client inspection report shall be signed by the client engineers and contractor. These documents shall then become part of the contract.

(h) FAT meeting minutes duly signed by the contractor and the client representative shall form part of official project documentation and shall be required by the client to approve payment processing by the bank. As part of the terms of letter of credit.

(i) Client will give consent for shipping ONLY after ALL the issues discussed in the minutes and noted in the client inspection report have been rectified and evidence given to the client.

5.1.8.4 Packing, Transportation and Storage

5.1.8.4.1 The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit and temporary storage up to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling and exposure to extreme temperatures, salt and precipitation. Packing case size and weights shall take into consideration, the Goods’ final destination and the absence of heavy handling facilities at all points in transit. Indoor electrical equipment must be enclosed in welded polythene envelopes inside packing cases and the envelopes shall be evacuated or have a desiccant inside.

5.1.8.4.2 The following information must be clearly stencilled or printed on each packing case, crate, cask, drum, bundle or loose piece, care being taken that the number and other particulars on each package agree with those entered in the packing list accompanying the Invoice:

(a) Employer's Identity
(b) Supplier's Identity
(c) Destination
(d) Project name
5.1.8.4.3 The marking above shall be durable and upon the body of the package. Marking upon a batten fastened on the case, etc. shall not be used. In the case of bags, bundles and loose pieces, the shapes of which do not permit the marks to be put on the actual package, each bag, bundle or loose piece shall have two metal labels each with two holes securely fastened by independent wires. Each label shall be die-stamped with the above particulars.

5.1.8.4.4 The Contractor shall be responsible for all transportation from manufacturing site to the power stations.

5.1.8.4.5 Goods shall only be shipped from factory to site after approval by the procuring entity.

5.1.8.4.6 Procuring entity shall give clearance for shipment of the equipment only after: all the finalised and approved Drawings, Instruction and maintenance manuals and software have been handed over to the client; any problems noted during FAT have been rectified and upon receipt of Authentic certified copies of the factory Test Reports.

5.1.8.4.7 Contractor will be responsible for equipment offloading and placement at the power station control room or store as detailed in the scope of supply.

5.1.9 WARRANTY

5.1.9.1 Suppliers Warranty

(a) The Contractor shall warrant that ALL goods supplied under the Contract are brand new, unused, of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

(b) The Contractor shall warrant that all Goods supplied under this contract shall have no defect arising from design, materials, workmanship (labour) or from any act / omission of the Contractor or manufacturer.

(c) Contractor further shall warrant that goods supplied under this contract shall not develop defects under normal use of the supplied Goods in the conditions prevailing in the country of final destination and site conditions as specified in this tender.
(d) Contractor shall replace any goods and software that fail within the **warranty period of two years** due to defects arising from conditions in clause (a), (b) and (c) above

(e) This warranty shall remain valid for **twenty-four (24) months** after arrival of equipment at site for ALL goods in scope of supply

(f) The bidder guarantees supplying maintenance spares and services as well as repairing of the supplied systems where called upon to do so after expiry of the warranty period at procuring entity’s cost for a period of 10 years.

(g) Bidder shall provide a signed letter in their letterhead committing to offer a **two-year** warranty meeting the above conditions if awarded the tender.

### 5.1.9.1.2 Manufacturer warranty

(a) Manufacturer’s warranty shall be extended for all key equipment in scope of supply as detailed in particular technical specifications. Manufacturer warranty shall cover all defects arising from design, materials, or workmanship or from any act or omission of the Manufacturer.

(b) All key industrial grade equipment shall have a manufacturer warranty of at least five years from the date of supply.

(c) All key enterprise grade equipment shall have a manufacturer warranty of at least three years from the date of supply.

(d) Manufacturer’s warranty shall be clearly spelt out in submitted data sheets, catalogues or manufacturer authorisations.
5.2 SCOPE OF SUPPLY

5.2.1 PREAMBLE

5.2.1.1 The tenderer shall indicate make, type, model number and manufacturer of major equipment in the preliminary bill of materials.

5.2.1.2 All functions, devices, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary for the proper and safe completion, operation, and maintenance of the equipment in question, shall be deemed to be included in the scope of supply and shall be supplied.

5.2.1.3 Any alternative/ additional system or device considered necessary for providing complete effective and reliable system shall also be included in the scope of supply by the bidder.

5.2.1.4 In the event of any conflict between the particular specifications and the Scope of supply, the particular specifications shall prevail. In the event of any conflict between scaled dimensions and figures on the Drawings, the figures shall prevail.

5.2.1.5 Should the Bidder find discrepancies or omissions in these Specifications or, should they be in doubt as to their meaning, they should immediately contact the Project Manager for interpretation, clarification or correction thereof before submitting their Bid.

5.2.1.6 All the system and devices listed under scope of supply are to use the station auxiliary DC power supply of 110VDC or 240VAC/415VAC. Where power supply units or power transformers are required to power the devices, they shall be part of scope of supply irrespective of whether such device has been included in the scope of supply by the procuring entity.

5.2.2 GENERAL SCOPE OF SUPPLY

5.2.2.1 Supply, assembly, testing and delivery (DDP incoterms) of complete 42u RCC Operations server cabinet and RCC DMZ server cabinet to Kamburu power station control room. Procurement, installation into the cabinets and testing of Rackmount servers, workstations, security appliances, ethernet switches, PDU, KVM console and all other equipment as detailed in the specifications.

5.2.2.2 Supply, assembly, testing and delivery (DDP incoterms) of complete SCADA LCC panels and process LAN panels to Kamburu, Kiambere, Kindaruma, Gitaru, Masinga and Turkwel power station control rooms. Procurement, installation into the panels and testing of Rackmount industrial PC, Industrial ethernet switches, industrial PTP
grandmaster clock, industrial security appliances, thin client, Industrial touch monitor, DCF77 time code output converter and all other equipment as detailed in the specifications.

5.2.2.3 Supply, testing and delivery (DDP incoterms) of operator workstation terminals consisting of dual LCD display, thin clients, KVM switch and all accessories (as loose items) as detailed in specifications to Kamburu, Kiambere, Kindaruma, Gitaru, Masinga and Turkwel power station control rooms.

5.2.2.4 Supply, testing and delivery (DDP incoterms) of touch screen Industrial panel PC and digital power & energy meters and any other specified PLC panel accessories (as loose items) as detailed in specifications to Kamburu, Kiambere, Kindaruma, Gitaru, Masinga and Turkwel power station control rooms.

5.2.2.5 Supply, testing and delivery (DDP incoterms) of tools & accessories and spares as detailed in specifications to Gitaru power station store.

5.2.2.6 Provision of perpetual software licences for Software in scope of supply; provision of three-year licences for all Subscription based software in scope of supply and provision of three-year basic software support for all applicable software in scope of supply.

5.2.2.7 Installation and configuration of all software in scope of supply into the hardware equipment as detailed in specifications.

5.2.2.8 Carry out Configuration and initialisation of all equipment in scope of supply as per procuring entity requirements and specifications prior to FAT.

5.2.2.9 Carry out Factory Acceptance testing of all equipment (with software installed and configured) in scope of supply witnessed by the procuring entity at the manufacturer’s factory. Provision of factory training at point of manufacture or assembly of panel as detailed in the specifications.

5.2.2.10 Provision of site training after arrival equipment at site. Training to be carried out at procuring entity’s facilities.

5.2.2.11 Provision of commissioning support during installation and commissioning of the supplied equipment by procuring entity.

5.2.2.12 Provision of online support as detailed in the specifications.

5.2.2.13 Provision of warranty and after sale services as detailed in the specifications.

5.2.2.14 Provision of all technical documentation as detailed in clause 5.1.7 of specifications.

5.2.2.15 Provision of any other goods or services not mentioned or included in this tender but which the contractor deems critical for the completion of the contract. These shall be itemized by the bidder in the offer and price schedule where necessary.
5.2.3 SCADA RCC SERVER CABINETS SCOPE OF SUPPLY

5.2.3.1 General

Bidder shall supply two server cabinets as detailed below

5.2.3.1.1 One (1) fully configured and assembled SCADA DMZ server cabinet, complete with two rear doors, front door, side panels, mounting rails, gladding plates, base plate etc as detailed in particular specifications shall be provided housing the following major equipment

(a) Three (3) Rack mount VM Host Servers complete with licensed pre-installed software
(b) Two (2) Rack mount Network Attached Storage complete with licensed pre-installed software and two LTO external tape drives
(c) One (1) Rack mount Workstations complete with licensed pre-installed software
(d) Two (2) Rack mount enterprise cyber security appliance with licensed pre-installed software
(e) Two (2) Cisco Ethernet Switches complete with licensed pre-installed software
(f) One (1) Rack mount Integrated console LCD monitor, keyboard & 8 port KVM switch

5.2.3.1.2 One (1) fully configured and assembled SCADA Operations server cabinet, complete with two rear doors, front door, side panels, mounting rails, gladding plates, base plate etc as detailed in particular specifications shall be provided housing the following major equipment

(a) Three (3) Rack mount VM Host Servers complete with licensed pre-installed software
(b) One (1) Rack mount Workstations complete with licensed pre-installed software
(c) Four (4) Rack mount enterprise cyber security appliance with licensed pre-installed software
(d) Two (2) Cisco Ethernet Switches complete with licensed pre-installed software
(e) One (1) Rack mount Integrated console LCD monitor, keyboard & 8 port KVM switch
5.2.3.2 **VM Host servers**

5.2.3.2.1 **Six (6)** rack mount servers meeting requirements in particular specifications shall be mounted into the two cubicles.

5.2.3.2.2 Each server shall be pre-installed with software as detailed in software scope of supply.

5.2.3.2.3 All devices and components required to assemble the servers into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.2.4 Servers offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted server computer irrespective of whether these features have been specified in this scope or specifications.

5.2.3.2.5 Each server shall have minimum of the following:

(a) One hyper threaded x86–64 intel® Xeon® gold series or intel® Xeon® platinum series processor with at least 18 cores, each with a clock speed of at least 3.0Ghz

(b) 256 GB, RDIMM, 2666MT/s RAM

(c) Two (2), 960GB eMLC SSD storage

(d) Eight (8) 1Gb ethernet ports

(e) Two (2) 10Gb ethernet ports

(f) Two (2) Hot plug, dual redundant power supply units (1+1)

5.2.3.3 **Network attached Storage**

5.2.3.3.1 **Two (2)** rack mount storage servers meeting requirements in particular specifications shall be mounted into the two cubicles.

5.2.3.3.2 Each server shall be pre-installed with software as detailed in software scope of supply.

5.2.3.3.3 All devices and components required to assemble the servers into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.3.4 Servers offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted server computer irrespective of whether these features have been specified in this scope or specifications.

5.2.3.3.5 Each server shall have minimum of the following:

(a) One (1) x86–64 intel® Xeon® scalable processor with at least 6 cores, each with a clock speed of at least 1.7Ghz

(b) At least 64 GB RAM
(c) Two (2), 400GB eMLC SSD (for OS)
(d) Twelve (12), 2TB, 10K HDD storage
(e) Two (2) 1Gb ethernet ports
(f) Two (2) 10Gb ethernet ports
(g) Two (2) Hot plug, dual redundant power supply units (1+1)

5.2.3.3.6 Two (2) 12TB LTO external tape drives shall be supplied installed and deployed for backing up the NAS each with a minimum of the following
(a) 12TB native capacity/30TB compressed
(b) Five (5) 12TB LTO media cartridge
(c) One (1) tape cleaner
(d) 6GB/s SAS interface
(e) SAS interface cable

5.2.3.4 Workstation
5.2.3.4.1 Two (2) rack mount workstation meeting requirements in particular specifications shall be mounted into the two cubicles
5.2.3.4.2 Each workstation shall be pre-installed with software as detailed in software scope of supply
5.2.3.4.3 All devices and components required to assemble the workstation into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.
5.2.3.4.4 Workstation offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted workstation computer irrespective of whether these features have been specified in this scope or specifications.
5.2.3.4.5 Workstation shall have minimum of the following
(a) One (1) x86–64 intel® Xeon® scalable processor or Intel® Core™ i7 processor with at least 4 cores, each with a clock speed of at least 2.6Ghz
(b) At least 16 GB, DDR4, RDIMM ,2400MHz, RAM
(c) One (1), 512GB SSD storage
(d) Four (4) 1Gb ethernet ports
(e) One (1) power supply unit

5.2.3.5 Cisco ethernet Switches
5.2.3.5.1 Four (4) rack mount Cisco 3850-24XU-S meeting requirements in particular specifications shall be mounted into the two cubicles.
5.2.3.5.2 Each ethernet switch shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor
5.2.3.5.3 All devices and components required to assemble the switches into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.5.4 Ethernet switch shall have minimum of the following
(a) Twenty-four (24), 10/100/1000 (UPOE) Downlink Ports
(b) Two (2) 1000 base-F fiber optic SFP Uplink ports, with LC SFP modules
(c) At least 4 GB RAM
(d) Two (2) Hot plug, dual redundant power supply units (1+1)

5.2.3.6 **Enterprise Cyber Security Appliance/Gateway**

5.2.3.6.1 *Six (6)* rack mount enterprise cyber security appliance meeting requirements in particular specifications shall be mounted into the two cubicles.

5.2.3.6.2 Each appliance shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor

5.2.3.6.3 All devices and components required to assemble the appliance into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.6.4 Each enterprise cyber security appliance shall have a minimum of the following
(a) One dual core processor
(b) At least 16 GB RAM
(c) One (1), 240GB SSD
(d) Six (6) 1Gb ethernet ports
(e) 10 Gbps firewall throughput

5.2.3.7 **Integrated console LCD monitor, keyboard & 8 port KVM switch**

5.2.3.7.1 *Two (2)* Integrated console devices meeting all specifications in particular specifications shall be mounted into the two cubicles (one per cubicle)

5.2.3.7.2 Each Shall consist of:
(a) 19” LED-backlit LCD monitor
(b) Rear 8-port KVM switch.
(c) Illuminated keyboard and touch pad
(d) Dual Rail housing

5.2.3.7.3 All devices and components required to assemble the console into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.7.4 Each console shall be configured and connected to all computers in the cubicle
5.2.3.8 Networking Accessories

5.2.3.8.1 A minimum of the following networking equipment and accessories meeting the particular technical specifications shall be supplied and installed into each server cabinet

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RJ45, Cat7, 24 port, shielded Patch panels</td>
<td>pieces</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>24 port rack mount Fibre optic patch panels (LC)</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Cat7 Twisted pair patch cords (from device to patch panels)</td>
<td>pieces</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>Cat7 RJ45-RJ45 Twisted pair patch cords (Patch panel to patch panel)</td>
<td>pieces</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>Single mode duplex LC-LC connector Fibre optic patch cords</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Rack mount cable entry panels for guiding the networking cables</td>
<td>pieces</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>KVM host adapter cable connectors</td>
<td>pieces</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>KVM console RJ45 patch cords</td>
<td>pieces</td>
<td>8</td>
</tr>
</tbody>
</table>

5.2.3.8.2 All devices and components required to network (local area network) all the major components in each cubicle as listed in clause 5.2.3.1 and connecting computers to the console shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.9 Cubicle and cubicle accessories

5.2.3.9.1 Two (2) server cabinets/cubicles shall be provided each with a minimum of the following parts and accessories

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front perforated door</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Rear perforated door</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Side panels</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Roof plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Base plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Gladding plate</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Cable glands</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Frames</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Mounting rails</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Grounding bar</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Horizontal cable managers</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Vertical cable managers</td>
<td>lot</td>
<td>1</td>
</tr>
</tbody>
</table>
5.2.3.9.2 Quantity, type and size of **cable glands** shall depend on the number, size and type of cables to be terminated on the panel. Metallic glands to be provided for all the SWA cables listed below. Non-metallic cable glands may be provided for the rest. As a minimum the following cables will be terminated on each server cabinet by the procuring entity during installation, bidder to provide cable glands for each cable below plus 5 spares of each type.

(a) Fifteen (15) outdoor type armoured SSTP cat 7 ethernet cables (cables in scope of supply under accessories)

(b) Four (4) four core,4mm2 SWA cable (cable in scope of supply under accessories)

(c) Four (4) four pair armoured fibre optic cable (cable not in scope of supply)

(d) Other cables – details to be provided at design stage

5.2.3.9.3 All devices and components usual and necessary for a complete functional enterprise server cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.10 **Electrical accessories**

5.2.3.10.1 A minimum of the following electrical devices and accessories meeting the particular technical specifications shall be supplied and installed into each server cabinet:

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rack mount Sixteen Outlet (C13),240 V AC,32A PDU</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>C13-C14 Power cords</td>
<td>pieces</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>Terminal blocks</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>32A Double pole AC circuit breakers for PDU supply.</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>16A Double pole AC circuit breakers for general panel supplies</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>Description</td>
<td>UOM</td>
<td>Quantity</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>6</td>
<td>3A double pole AC circuit breaker for fan supplies</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>British type (BS 1363) rack mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>British type (BS 1363) DIN mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Euro type (CEE 7/3) DIN mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2.5mm² electrical copper wires for internal panel wiring</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>4mm² electrical copper wires for panel Earthing</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Panel cooling vent fans each with Air throughput of at least 750m³/h</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>Panel cooling temperature-controlled switch (Thermostat)</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>LED panel lighting</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Door operated switch</td>
<td>pieces</td>
<td>2</td>
</tr>
</tbody>
</table>

5.2.3.10.2 All electrical devices and components required for power supply and power supply protection for the major components in each cubicle as listed in clause 5.2.3.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.3.11 Other devices
5.2.3.11.1 All functions, devices, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary for the proper and safe completion, operation, and maintenance of the server cabinets and the major equipment in each cubicle as listed in clause 5.2.3.1, shall be included in the scope of supply and shall be supplied and installed into the cabinets.

5.2.3.11.2 Contractor shall be responsible for all the cabinet assembly and accessories

5.2.4 SCADA LCC PANELS SCOPE OF SUPPLY

5.2.4.1 General

Bidder shall supply two control panels with the equipment mounted as detailed
5.2.4.1.1 Six (6) fully configured and assembled SCADA LCC panels one for each plant, complete with glanding plates, base plates, Front door with polycarbonate window, rear door, frames, mounting rails etc. as detailed in in particular specifications shall be provided each housing the following major equipment
(a) Two (2) Rack mount industrial PC complete with licensed pre-installed software
(b) One (1) Thin client PC complete with licensed pre-installed software
(c) Four (4) Rack mount industrial Ethernet Switches complete with licensed pre-installed software
(d) One (1) Rack mount PTP grandmaster clock and time server with GNSS receiver complete with licensed pre-installed software
(e) Four (4) Industrial cyber security appliance with licensed pre-installed software
(f) One (1) industrial grade LCD touch monitor
(g) One (1) 4port KVM switch
(h) One (1) DCF77 Time code converter

5.2.4.2 Rack mount industrial PC
5.2.4.2.1 Two (2) rack mount fan less industrial PC meeting requirements in particular specifications shall be mounted into each of the LCC panels (total of 12).
5.2.4.2.2 Each rack mount industrial PC shall be pre-installed with software as detailed in software scope of supply
5.2.4.2.3 All devices and components required to assemble the rack mount industrial PC into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.
5.2.4.2.4 Rack mount industrial PC offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted industrial PC irrespective of whether these features have been specified in this scope or specifications
5.2.4.2.5 Each Industrial PC shall have minimum of the following:
(a) One (1) hyper threaded x86–64 intel® Xeon® processor with at least 4 cores, each with a clock speed of at least 2.8 Ghz
(b) 32 GB, DDR4, 2133 MHz, ECC RAM
(c) Two (2), 256GB industrial grade SLC SSD storage
(d) Four (4) 10/100/1000 Mbps, RJ45 copper ports
(e) Two (2) 10/100/1000 Mbps SFP ports each with Gigabit ethernet SFP module with LC ports
(f) Two (2) hot-swappable dual redundant 110–240, Vdc/Vac; power supply modules. (compatible with both AC and DC sources)

(g) Conformal coated circuit boards

(h) Fan less

5.2.4.2.6 Each Industrial PC designed and type tested at a minimum as per:

(a) IEC 61850-3:2013, class 1

(b) IEEE 1613-2009, class 1

(c) IEC 61000-6-2:2005

(d) IEC 61000-6-4:2006

(e) IEC 60255-26:2013

(f) IEC 60255-27:2013

(g) IEC 61000-4-2:2008, IEEE C37.90.3-2001, Severity Level: 2, 4, 6, 8 kV contact discharge; 2, 4, 8, 15 kV air discharge

(h) IEC 60068-2-30:2005, Severity Level: 12 + 12-hour cycle; 25°C to 55°C, 6 cycles, >93% relative humidity

(i) IEC 60068-2-78:2001; Severity Level: 40°C, 240 hours, >93% relative humidity


(k) IEC 60255-21-2:1988; Severity Level: Shock Withstand, Bump Class 1; Shock Response Class 2

and as detailed in particular specifications.

5.2.4.3 Thin client PC

5.2.4.3.1 One (1) fan less thin client PC meeting requirements in particular specifications shall be mounted into each of the LCC panels (total of 6).

5.2.4.3.2 Each Thin client PC shall be pre-installed with software as detailed in software scope of supply

5.2.4.3.3 Thin client PC offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional thin client computer irrespective of whether these features have been specified in these specifications or not.

5.2.4.3.4 Each thin client shall have minimum of the following

(a) One (1) Quad core processor with a clock speed of at least 2.0Ghz

(b) At least 8 GB DDR4 RAM

(c) At least 32GB flash memory rated at least 100TBW (terabytes written)

(d) Two (2) video display support

(e) One (1) 1Gb ethernet port
5.2.4.4 **Industrial ethernet Switches**

5.2.4.4.1 **Four (4) rack mount fan less industrial Ethernet Switches** meeting requirements in particular specifications shall be mounted into each of the LCC panels (total of 24).

5.2.4.4.2 Each industrial ethernet switch shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor.

5.2.4.4.3 All devices and components required to assemble the ethernet switches into the panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.4.4 Ethernet switch shall have minimum of the following:

(a) Twenty-four (24), total ethernet Ports

(b) At least Four (4) 10/100/1000 Mbps, RJ45 copper ports

(c) At least Four (4) 10/100/1000 Mbps SFP ports each with Gigabit ethernet SFP module with LC ports

(d) At least 512MB RAM

(e) Two (2) hot-swappable dual redundant 110–240, Vdc/Vac; power supply modules. (compatible with both AC and DC sources)

(f) fan less

(g) Standards and testing

(i) IEEE 1613–2009, KEMA certified

(ii) IEC 61850-3:2013, KEMA certified

(iii) IEC 61850-90-4, KEMA certified


5.2.4.5 **Industrial PTP Grandmaster clock & time server with GNSS receiver**

5.2.4.5.1 **One (1) rack mount PTP Grandmaster clock & time server with GNSS receiver meeting requirements in particular specifications** shall be mounted into each of the LCC panels (total of 6).

5.2.4.5.2 Each industrial clock/time server shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor.
## 5.2.4.5.3
All devices and components required to assemble the industrial clock/time server into the panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

## 5.2.4.5.4
Rack mount PTP Grandmaster clock & time server with GNSS receiver offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted industrial clock/timeserver irrespective of whether these features have been specified in this scope or specifications.

## 5.2.4.5.5
Ethernet switch shall have a minimum of the following
(a) GNSS (GPS/GLONAS etc) receiver
(b) OCXO clock oscillator with accuracy to UTC of at least 5 μs per day
(c) At least Four (4) PTP (IEEE 1588v2) time sync output Ethernet ports with at least ±100ns accuracy
(d) At least Four (4) IRIG-B/PPS time sync output ports with at least ±100ns accuracy
(e) At least two (2) 10/100Mbps, RJ45 copper ports
(f) At least Four (2) 10/100Mbps Fibre optic ports with LC connectors
(g) Two (2) hot-swappable dual redundant 110–240, Vdc/Vac; power supply modules. (compatible with both AC and DC sources)
(h) IP67 Antenna, surge protector, connector cables and all necessary Antenna mounting brackets and accessories
(i) fan less
(j) Standards and testing
   (i) IEEE 1613-2009,
   (ii) IEC 61850-3
   (iii) IEC 60068-2-2:2007, Severity Level: 16 hours at +85°C
   (iv) IEC 60068-2-30:2005, Severity Level: 25° to 55°C, 6 cycles, relative humidity: 95%

Others as detailed in particular specifications

## 5.2.4.6
**Industrial Cyber security appliance/Gateway**

### 5.2.4.6.1
**Four (4)** DIN mount industrial cyber security appliance meeting requirements in particular specifications shall be mounted into each of the LCC panels (total of 24).

### 5.2.4.6.2
Each appliance shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor
5.2.4.6.3 All devices and components required to assemble the appliance into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.6.4 Each industrial cyber security appliance shall have a minimum of the following
(a) 2 Gbps firewall throughput,
(b) 450 Mbps VPN throughput
(c) Six (6) 1Gb ethernet ports
(d) Two (2) power supply units i.e. 220-240VAC PSU and 110V DC PSU
(e) fan less
(f) Standards and testing
   (i) IEEE 1613
   (ii) IEC 61850-3

5.2.4.7 **Industrial grade 19" LCD touch monitor**

5.2.4.7.1 One (1) industrial grade LCD touch monitor meeting all specifications in particular specifications shall be mounted into each of the LCC panels (total of 6).

5.2.4.7.2 Each industrial grade LCD touch monitor shall have a minimum of the following
(a) 19" LCD touch monitor
(b) stainless steel bezel
(c) Front IP66 Ingress protection
(d) Screen Protector
(e) Video input and USB touch screen output

5.2.4.7.3 All devices and components required to mount the industrial touch monitor into the panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.7.4 Touch screen input shall be configured into the thin client and video output shall be connected to KVM switch console ports

5.2.4.8 **DCF77 Time code Output converter**

5.2.4.8.1 One (1) IRIG-B /PTP to DCF77 time synchronisation signal converter shall be supplied meeting requirements in the particular specifications and installed into each of the LCC panels (total of 6).

5.2.4.8.2 Each DCF77 time code output converter shall have a minimum of the following
(a) A BNC/serial IRIG-B time source input or a PTP time source input
(b) 24V DC DCF 77-time pulses output for connection to at least sixteen devices in a daisy chain.

(c) DCF77 time output accuracy of at least ±100 µs to the input reference

(d) 110V DC to 24V DC power supply unit

(e) Cables for connecting to the grandmaster clock

5.2.4.8.3 The DCF77 time code output converter shall be connected to the PTP grandmaster clock IRIG-B or PTP time outputs by the contractor, all cables and accessories necessary for this shall be provided

5.2.4.9 **Four port KVM switch**

5.2.4.9.1 **One (1)** Four port KVM switch meeting all specifications in particular specifications shall be mounted into each of the LCC panels (total of 6).

5.2.4.9.2 Each Four port KVM switch shall have a minimum of the following

   (a) Four port KVM switch
   
   (b) Four host adapter cables and
   
   (c) one console video and USB cables

5.2.4.9.3 All devices and components required to mount the KVM switch into the panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.9.4 Each KVM switch shall be configured and connected to all computers in the panel

5.2.4.10 **Networking Accessories**

5.2.4.10.1 A minimum of the following networking equipment and accessories meeting the particular technical specifications shall be supplied and installed into each LCC panel (six in total)

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RJ45, Cat7, 24 port, shielded Patch panels</td>
<td>pieces</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>24 port rack mount Fibre optic patch panels (LC)</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Cat7 Twisted pair patch cords (from device to patch panels)</td>
<td>pieces</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>Cat7 RJ45-RJ45 Twisted pair patch cords (Patch panel to patch panel)</td>
<td>pieces</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>Single mode duplex LC-LC connector Fibre optic patch cords</td>
<td>pieces</td>
<td>4</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Rack mount cable entry panels for guiding the cat 7 cables</td>
<td>pieces</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>KVM host adapter cable connectors</td>
<td>pieces</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>KVM console connector cables</td>
<td>Lot</td>
<td>1</td>
</tr>
</tbody>
</table>

5.2.4.10.2 All devices and components required to network (local area network) all the major components in each panel as listed in clause 5.2.4.1 and connecting computers to the KVM switch shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.11 Cubicle and cubicle accessories

5.2.4.11.1 Six (6) SCADA LCC panels (one per plant) shall be provided each with a minimum of the following parts and accessories

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rack mount console keyboard with rack mount drawer mounting and a 108-Key US ANSI English Layout Keyboard with 2m USB cord and USB optical mouse</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Front door with polycarbonate window</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Rear door</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Side panels</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Roof plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Base plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Gladding plate</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Cable glands</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Frames</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Mounting rails</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Grounding bar</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Cable trunking</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Device labelling</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Cable labelling</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Keys</td>
<td>Set</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Door locks</td>
<td>Set</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Blanking plates</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>DIN rails</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>Exhaust fan Mounting</td>
<td>Lot</td>
<td>1</td>
</tr>
</tbody>
</table>
5.2.4.11.2 Quantity, type and size of **cable glands** shall depend on the number, size and type of cables to be terminated on each panel. Metallic glands to be provided for all the SWA cables listed below. Non-metallic cable glands may be provided for the rest. As a minimum the following cables will be terminated on each SCADA LCC panel by the procuring entity during installation, bidder to provide cable glands for each cable plus 5 spares of each type.

(a) Twenty (20) outdoor type armoured SSTP cat 7 ethernet cables (cables in scope of supply under accessories)

(b) Five (5) four core,4mm² SWA cable (cable in scope of supply under accessories)

(c) One (1) 19 core,1.5mm² SWA cable (cable in scope of supply under accessories)

(d) Four (4) four pair armoured fibre optic cable (cable not in scope of supply)

(e) Other cables – details to be provided at design stage

5.2.4.11.3 All devices and components usual and necessary for a complete functional SCADA LCC control panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.12 **Electrical accessories**

5.2.4.12.1 A minimum of the following electrical devices and accessories meeting the particular technical specifications shall be supplied and installed into each SCADA LCC panel

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110V DC Double pole Miniature circuit breakers</td>
<td>pieces</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>32A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>16A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>6A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>3A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Terminal blocks for auxiliary supplies wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Terminal blocks for control wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Panel cooling vent fans each with Air throughput of at least 750m³/h</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>1.5mm² electrical copper wires for internal panel control wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2.5mm² electrical copper wires for internal panel auxiliary supplies wiring</td>
<td>lot</td>
<td>1</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>4mm² electrical copper wires for panel Earthing</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>British type (BS 1363) rack mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>British type (BS 1363) DIN mount socket strip</td>
<td>pieces</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>Euro type (CEE 7/3) DIN mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Panel LED lighting lamps</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Door operated switches</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Panel heater</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Panel Thermostat</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>Panel Hygrostat</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>Others (bidder to itemize)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.4.12.2 All electrical devices and components required for power supply and power supply protection for the major components in each panel as listed in clause 5.2.4.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.4.13 Other devices

5.2.4.13.1 All functions, devices, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary for the proper and safe completion, operation, and maintenance of the control panels and the major equipment in each panel as listed in clause 5.2.4.1, shall be included in the scope of supply and shall be supplied and installed into the panels.

5.2.4.13.2 Contractor shall be responsible for all the panel assembly and accessories

5.2.5 SCADA PROCESS LAN PANELS SCOPE OF SUPPLY

5.2.5.1 General

Bidder shall supply two control panels with the equipment mounted as detailed.

5.2.5.1.1 Six (6) fully configured and assembled SCADA Process LAN panels one for each plant, complete with glanding plates, base plates, Front door with polycarbonate window, rear door, frames, mounting rails etc. as detailed in in particular specifications shall be provided each housing the following major equipment:

(a) Two (2) Rack mount industrial Ethernet Switches complete with licensed pre-installed software
5.2.5.2 **Industrial ethernet Switches**

5.2.5.2.1 **Two (2)** rack mount industrial Ethernet Switches meeting requirements in particular specifications shall be mounted into each of the Process LAN panels (total of 12).

5.2.5.2.2 Each industrial ethernet switch shall be preinstalled with licensed software and pre-configured to suit the Network architecture provided to the contractor.

5.2.5.2.3 All devices and components required to assemble the ethernet switches into the panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.5.2.4 Ethernet switch shall have minimum of the following:
   (a) Twenty-four (24), total ethernet Ports
   (b) At least Four (4) 10/100/1000 Mbps, RJ45 copper ports
   (c) At least Four (4) 10/100/1000 Mbps SFP ports each with Gigabit ethernet SFP module with LC ports
   (d) At least 512MB RAM
   (e) Two (2) hot-swappable dual redundant 110–240, Vdc/Vac; power supply modules. (compatible with both AC and DC sources)
   (f) Standards and testing
      (i) IEEE 1613-2009, KEMA certified
      (ii) IEC 61850-3:2013, KEMA certified
      (iii) IEC 61850-90-4, KEMA certified
      Others as detailed in particular specifications

5.2.5.3 **Networking Accessories**

5.2.5.3.1 A minimum of the following networking equipment and accessories meeting the particular technical specifications shall be supplied and installed into each Process LAN panel (six in total)

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RJ45, Cat7, 24 port, shielded Patch panels</td>
<td>pieces</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>24 port, rack mount Fibre optic patch panels (LC)</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Cat7 Twisted pair patch cords (from Switches to patch panels)</td>
<td>pieces</td>
<td>48</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Single mode duplex LC-CL connector Fibre optic patch cords</td>
<td>pieces</td>
<td>2</td>
</tr>
</tbody>
</table>

5.2.5.3.2 All devices and components required to network (local area network) all the major components in each panel as listed in clause 5.2.5.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.5.4 Cubicle and cubicle accessories

5.2.5.4.1 Six (6) Process LAN panels (one per plant) shall be provided each with a minimum of the following parts and accessories

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front door with polycarbonate window</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Rear door</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Side panels</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Roof plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Base plate</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Gladding plate</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Cable glands</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Frames</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Mounting rails</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Grounding bar</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Cable trunking</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Device labelling</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Cable labelling</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Keys</td>
<td>Set</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Door locks</td>
<td>Set</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Blanking plates</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>DIN rails</td>
<td>Lot</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Exhaust fan Mounting</td>
<td>Lot</td>
<td>1</td>
</tr>
</tbody>
</table>

5.2.5.4.2 Quantity, type and size of cable glands shall depend on the number, size and type of cables to be terminated on each panel. Metallic glands to be provided for all the SWA cables listed below. Non-metallic cable glands may be provided for the rest. As a minimum the following cables will be terminated on each SCADA Process LAN panel by the procuring entity during installation, bidder to provide cable glands for each cable plus 5 spares of each type.
(a) Forty (40) outdoor type armoured SSTP cat 7 ethernet cables (cables in scope of supply under accessories)
(b) Five (5) four core, 4mm2 SWA cable (cable in scope of supply under accessories)
(c) One (1) 19 core, 1.5mm2 SWA cable (cable in scope of supply under accessories)
(d) Four (4) four pair armoured fibre optic cable (cable not in scope of supply)
(e) Other cables – details to be provided at design stage

5.2.5.4.3 All devices and components usual and necessary for a complete functional SCADA Process LAN control panel shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.5.5 Electrical accessories

5.2.5.5.1 A minimum of the following electrical devices and accessories meeting the particular technical specifications shall be supplied and installed into each SCADA Process LAN panel

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>UOM</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110V DC Double pole Miniature circuit breakers</td>
<td>pieces</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>16A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6A Double pole AC circuit breakers</td>
<td>pieces</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3A double pole AC circuit breakers</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Terminal blocks for auxiliary supplies wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Terminal blocks for control wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2.5mm2 electrical copper wires for internal panel wiring</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>4mm2 electrical copper wires for panel Earthing</td>
<td>lot</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>British type (BS 1363) rack mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>British type (BS 1363) DIN mount socket strip</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Euro type (CEE 7/3) DIN mount socket strip</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Panel LED lighting lamps</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>Door operated switches</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Panel cooling vent fans each with Air throughput of at least 750m3 /h</td>
<td>pieces</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Panel heater</td>
<td>pieces</td>
<td>1</td>
</tr>
<tr>
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<td>Panel Thermostat</td>
<td>pieces</td>
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<tr>
<td>17</td>
<td>Panel Hygrostat</td>
<td>pieces</td>
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Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
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<th>Quantity</th>
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<tbody>
<tr>
<td>18</td>
<td>Others (bidder to itemize)</td>
<td></td>
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</tbody>
</table>

5.2.5.5.2 All electrical devices and components required for power supply and power supply protection for the major components in each panel as listed in clause 5.2.4.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.5.6 Other devices

5.2.5.6.1 All functions, devices, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary for the proper and safe completion, operation, and maintenance of the control panels and the major equipment in each panel as listed in clause 5.2.5.1, shall be included in the scope of supply and shall be supplied and installed into the panels

5.2.5.6.2 Contractor shall be responsible for all the panel assembly and accessories

(a)

5.2.6 OPERATOR WORKSTATION TERMINALS SCOPE OF SUPPLY

5.2.6.1 General

Bidder shall supply Twelve (12) operator workstation terminals, six workstation terminals will be delivered to Kamburu and two terminals each for the other five plants. Each terminal shall consist of the following components supplied as loose items to be mounted/positioned at the operator desks by the procuring entity

5.2.6.1.1 Two (2) 27.0 Inch LED backlit LCD monitor for each workstation terminal (total of 24)

5.2.6.1.2 Two (2) Thin client PC’s complete with licensed pre-installed software for each workstation terminal (total of 24)

5.2.6.1.3 One (1) two-port dual display KVM Switch for each workstation terminal (total of 12)

5.2.6.1.4 Operator work station terminal accessories

5.2.6.2 27.0 Inch LED backlit LCD monitor

5.2.6.2.1 Two (2) 27.0 Inch LED backlit LCD monitor for each workstation terminal (total of 24) shall be supplied.
5.2.6.2.2 All devices and components required to assemble/mount display into the operator desk (by the procuring entity) shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.6.2.3 Each 27.0 Inch LED backlit LCD monitor shall have a minimum of the following:
   (a) 27.0-inch (68.5 cm) LED backlit LCD display monitor
   (b) Maximum display resolution of at least 2560 x 1440
   (c) Four (4) video inputs
   (d) enterprise grade designed for 24/7 operation
   (e) Base, mounting brackets, screen protector and all other accessories for an ergonomic workstation monitor.

5.2.6.3 **Thin client PC**

5.2.6.3.1 **Two (2)** fan less thin client PC meeting requirements in particular specifications for each workstation terminal (total of 24) shall be supplied for operator workstations.

5.2.6.3.2 Each Thin client PC shall be pre-installed with software as detailed in software scope of supply.

5.2.6.3.3 Thin client PC offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional thin client computer irrespective of whether these features have been specified in these specifications or not.

5.2.6.3.4 Each thin client shall have minimum of the following
   (a) One (1) Quad core processor with a clock speed of at least 2.0Ghz
   (b) At least 8 GB DDR4 RAM
   (c) At least 32GB flash memory rated at least 100TBW (terabytes written)
   (d) Two (2) video display support
   (e) One (1) 1Gb ethernet port
   (f) One (1) power supply unit

5.2.6.4 **Two-port dual display KVM switch**

5.2.6.4.1 **One (1)** two port dual display KVM switch meeting all specifications in particular specifications for each workstation terminal (total of 12) shall be supplied.

5.2.6.4.2 Each two-port dual display KVM switch shall have a minimum of the following
   (a) Two console display ports
   (b) Four host display ports, two per host
   (c) Four host adapter cables and
(d) Two console video and USB cables

5.2.6.4.3 All devices and components required for a fully configured operational two port dual display KVM shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.6.5 **Operator work station terminal accessories**

A minimum of the following components shall be supplied for each workstation terminal as loose items to be mounted/positioned at the operator desks by the procuring entity

5.2.6.5.1 One (1) 108-Key US ANSI English Layout Keyboard with 2m USB cable (total of 12)

5.2.6.5.2 One (1) USB optical Mouse with 2m USB cable (total of 12)

5.2.6.5.3 All required mounting bracket and accessories for desktop placement of LCD monitors, KVM switch and thin client PC’s for each workstation terminal

5.2.6.5.4 Any other relevant device or accessory necessary for optimal and ergonomic workstation terminal.

5.2.7 **PLC PANEL COMPONENTS SCOPE OF SUPPLY**

5.2.7.1 **General**

Bidder shall supply the following PLC panel components to each power plant as loose items to be installed by the procuring entity

5.2.7.1.1 Four (4) Panel mount, touch screen industrial PC complete with licensed pre-installed software for each plant (a total of 24)

5.2.7.1.2 Six (6) digital power & energy meters for each plant (a total 36)

5.2.7.2 **Panel mount, Touch Screen industrial PC**

5.2.7.2.1 Four (4) Panel mount, fan less, touch screen industrial PC meeting requirements in particular specifications shall be supplied as loose items to each plant (total of 24).

5.2.7.2.2 Each Panel mount, fan less, touch screen industrial PC shall be pre-installed with software as detailed in software scope of supply
5.2.7.2.3 All devices and components required to assemble the panel mount touch screen industrial PC into the PLC panel (by the procuring entity) shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.2.7.2.4 Panel mount touch screen industrial PC offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional panel mount touch screen industrial PC irrespective of whether these features have been specified in this scope or specifications.

5.2.7.2.5 Each panel mount touch screen industrial PC shall have minimum of the following:
   (a) One (1) hyper threaded x86-64 Intel® processor with at least 2 cores, each with a clock speed of at least 1.7 Ghz
   (b) 8 GB RAM
   (c) 15.6-inch multi-touch screen display
   (d) 64GB industrial grade SLC SSD storage
   (e) Two (2) 10/100/1000 Mbps, RJ45 copper ports
   (f) 24V DC power supply input
   (g) Fan less

5.2.7.2.6 Each Industrial PC designed and type tested at a minimum as per:
   (a) IEC 61850-3
   (b) IEEE 1613
   (c) IEC 61000-6-2
   (d) IEC 61000-6-4
   and as detailed in particular specifications.

5.2.7.3 Digital Power & Energy Meter

5.2.7.3.1 Six (6) Digital power and energy meter meeting requirements in particular specifications shall be supplied as loose items to each plant (total of 36).

5.2.7.3.2 Each Digital power & energy meter shall be pre-configured and all necessary software provided as detailed in software scope of supply.

5.2.7.3.3 Digital power & energy meter offered shall be complete with all hardware components, accessories, features and devices necessary for a complete Digital power & energy meter irrespective of whether these features have been specified in these specifications or not.

5.2.7.3.4 Each digital power and energy meter shall have minimum of the following:
   (a) DIN mount power meter unit with 3P4W terminals
   (b) Panel mount 96mm X 96mm remote LCD display unit
   (c) Four (4) 4–20mA analogue outputs
   (d) Two (2) RJ45 Ethernet ports
5.2.8 **TOOLS AND ACCESSORIES SCOPE OF SUPPLY**

Bidder shall supply tools and accessories to be utilised by the procuring entity to install and commission the delivered equipment. The tools and accessories shall be delivered to Gitaru power plant store. The following tools and accessories shall be supplied:

5.2.8.1 **Engineering workstation Laptops**

5.2.8.1.1 Four (4) Engineering workstation Laptop with preinstalled software & accessories and meeting all the requirements in particular specifications. Each workstation laptop shall have a minimum of the following features:

(a) One hyper threaded x86–64 intel® core i7® or core i9® 9th generation processor with at least 4 cores, each with a clock speed of at least 2.8Ghz
(b) 16 GB, DDR4-2400 RAM
(c) 512 GB, M.2 NVMe MLC Solid State Drive
(d) 1Gb ethernet port
(e) Enterprise grade rugged workstation laptop, tested as per as per MIL-STD-810G

5.2.8.2 **Network cable repair maintenance toolkit**

5.2.8.2.1 Shall consist of the following:

(a) Cable crimping tool Suitable for Cat5, Cat5e, cat7 and Cat 6 cable with 8P8C plugs.
(b) Network Cable Tester: That can test correspondingly double-twisted cables 1, 2, 3, 4,5, 6, 7, 8 and G. Should also judge wrong connection, short circuit and open circuit with two 9V batteries included.
(c) Wire Stripper Cutter.
(d) Wire Punch down Impact Tool.
(f) Cross screwdriver.
(g) ≥five hundred (500) of cat 7 8P8C RJ45 connectors with gold plate shield
(h) ≥Four (4) dozen Crystal head connector sheaths
(i) ≥Four (4) dozen of wall network faceplates
(j)  Four (4) dozen female connector RJ45 modules
(k)  Portable and Convenient Tool bag.

5.2.8.3  **Networking cables and accessories**

5.2.8.3.1 Shall consist of the following each meeting requirements in general technical specifications

(a)  Hundred (100) Factory made Cat7, RJ45-RJ45, 3 meters, Shielded, screened Twisted pair patch cords
(b)  Ten (10) Factory made Single mode duplex(pair) LC-LC connector Fibre optic patch cords
(c)  Ten (10) cable Rolls of Outdoor SSTP Cat 7, each roll measuring at least 300m
(d)  Ten (10) cable Rolls of indoor SSTP Cat 7, each roll measuring at least 300m

5.2.8.4  **Electrical cables and accessories**

5.2.8.4.1 Shall consist of the following each meeting requirements in general technical specifications

(a)  Five hundred (500) meters of 4X4mm sq. SWA Cable with coloured cores, brown, black, grey and blue-standard IEC AC phases colours
(b)  Five hundred (500) meters of 19X1.5mm sq. SWA Cable with numbered cores (1-19 sequentially) for controls

5.2.8.5  **Projectors**

5.2.8.5.1 Three (3) Ultrashort distance projectors for wall mounting and accessories as detailed in particular specifications
5.2.8.5.2 Two (2) Short distance desktop projector and accessories as detailed in particular specifications

5.2.9  **SPARES SCOPE OF SUPPLY**

5.2.9.1 Bidder shall supply spares of all critical equipment supplied under scope of this project.
5.2.9.2 All spares shall meet the requirements given in particular specifications and shall be preinstalled with software in similar fashion the main equipment.
5.2.9.3 Spares shall be similar in all manner to the other equipment supplied either installed in a panel or as a loose item
5.2.9.4 The spares shall be delivered to Gitaru power plant store.
5.2.9.5 All manufacturer recommended spares shall be supplied at no extra cost, bidder MUST factor in their costs all manufacturer recommended spares not listed by the procuring entity in this tender. Bidder shall itemise such spares in their bill of materials and bill of quantities.

5.2.9.6 A minimum of the following shall be supplied

5.2.9.6.1 Two (2) Rack mount Industrial Ethernet switches
5.2.9.6.2 Two (2) Rack mount industrial computers with all specified software as per specifications
5.2.9.6.3 One (1) Rack mount PTP Grandmaster clock/ Time server with integrated GPS receiver
5.2.9.6.4 Four (4) Industrial security Appliance with all specified software as per specifications
5.2.9.6.5 Four (4) thin Client PC with all specified software as per specifications
5.2.9.6.6 One (1) Rack mount VM Host Servers complete with licensed pre-installed software
5.2.9.6.7 Two (2) Rack mount Sixteen Outlet (C13),240 V AC,32A PDU
5.2.9.6.8 Four (4) 27.0 Inch LED backlit LCD monitor
5.2.9.6.9 Two (2) panel mount, touch screen, Industrial PC
5.2.9.6.10 Two (2) digital power & energy meters

5.2.10 **SOFTWARE SCOPE OF SUPPLY**

5.2.10.1 **General**

5.2.10.1.1 Bidder shall supply three categories of software

(a) Software pre-installed into the hardware equipment and with perpetual license

(b) Software not preinstalled into hardware (if necessary) with perpetual license

(c) Software with subscription licenses (where perpetual licences are not available). Where a subscription license is offered, except for cyber security functions as detailed in the particular specifications, the procuring entity
shall add into the bidders’ price the cost of software license subscription for twelve years prior to bid comparison during tender evaluation.

5.2.10.2 RCC Servers

5.2.10.2.1 Virtualisation
(a) Bidder shall supply and install into all the seven host servers (including the spare) in scope of supply all software necessary for server virtualisation
(b) VMware vSphere, 64-bit SHALL be used for server virtualisation
(c) Bidder shall at minimum supply two (2) VMware vSphere essential plus with perpetual licenses. The Software shall include the following
   (i) vSphere and associated features for six servers
   (ii) Two (2) VCenter server essentials (one per license)
   (iii) Hypervisor
   (iv) vMotion
   (v) High availability
(vi) Data protection and replication
(vii) vShield endpoint
(d) Three (3) year support to be provided

5.2.10.2.2 Operating Systems Software

Bidder shall supply and install into all the six host servers in scope of supply
a minimum of the following Microsoft windows perpetual Volume licenses:

(a) Fourteen (14) sets of 64-bit Microsoft windows 2016 server standard
edition each with 50 user CALS, two virtual machines and 16+2 additional
core licenses (18 core server). Bidder to license all the cores in their offered
server. A minimum of two and maximum of four virtual machines to be
pre-installed into each of the seven host servers. Two licenses (four virtual
machines each with 50 user CALS) to be provided for each of the seven
servers. Bidder to note that some licenses may be downgraded to windows
2012 R2 by the procuring entity if required prior to delivery. While pricing
bidder to quote the higher of the two (windows 2016/windows 2012 R2).
Bidder to note that each virtual machine shall have a minimum of 50 user
CAL’S.

(b) Four (4) Sets of ten (10) Microsoft Windows server 2016 remote desktop
services (RDS) client access licenses (CALs) for each set of core licenses
(total of 40 RDS CALs). These additional CALs will be installed into four of
the server’s virtual machines requiring this service.

(c) Six (6) Additional sets of Fifty (50) Microsoft Windows server 2016 user
client access licenses (CALs) for each set of core license (total of 300 extra
user CALs). These licences shall be added into six of the servers’ virtual
machines.

(d) Four (4) sets of Microsoft Windows server 2003 license each with ten (10)
user CALS for virtualising four existing physical servers.

(e) Six (6) sets Microsoft SQL server 2016 standard edition for 18 core servers
(bidder to license all the cores in their offered server) with ten (10) user
CALS each. These licences shall be added into six of the servers’ virtual
machines where they are required. Bidder to note that some licenses may be
downgraded to MS SQL server 2012 by the procuring entity if required
prior to delivery. While quoting bidder to quote the higher of the two (Ms
Sql 2016/Ms Sql 2012)

(f) Two (2) sets of 64-bit Microsoft Windows storage server 2016 standard
edition with 16 core license (bidder to license all the cores in their offered
5.2.10.3 Cyber Security Software

5.2.10.3.1 Bidder shall supply, install and configure all the software required for the operation of the cyber security appliances, security management server and features and settings necessary and usual for industrial control system cyber security solution.

5.2.10.3.2 Six (6) sets of cyber security software with perpetual licences and three-year subscription licences where allowed as detailed in particular specifications shall be supplied, installed and configured into the six (6) Enterprise grade cyber security appliances (gateways), each of the cyber security appliance/gateway shall contain the features and functions detailed in the particular specifications. The features and functions shall include:

(a) Next generation firewall
(b) Identity Awareness (identity services for identity-based firewall policy)
(c) IPsec VPN
(d) Intrusion Prevention System (IPS)
(e) Advanced Networking & Clustering for optimum performance and high availability (QoS prioritisation, load sharing and balancing, redundancy etc.)
(f) Mobile access (Secure SSL VPN access, two-factor authentication, Device/end-user pairing etc) for safe remote access from mobile devices
(g) Application control for SCADA/ICS protocols and devices with visibility to a minimum of the following protocols
   (i) IEC-60870-5-104
   (ii) IEC 60870-6 (ICCP)
   (iii) IEC 61850
   (iv) Modbus
   (v) OPC
   (vi) Profinet
   (vii) S7 (Siemens)
(h) URL Filtering
(i) Antivirus
(j) Anti-Spam
(k) Anti-Bot

5.2.10.3.3 Three (3) years software support for the enterprise cybersecurity appliance/gateway software to be provided.
5.2.10.3.4 Twenty-eight (28) sets of cyber security software perpetual licences and three-year subscription licences where allowed as detailed in particular specifications shall be supplied, installed and configured into the twenty-eight industrial grade cyber security appliances/gateways, each of the cyber security appliance/gateway shall contain the features and functions detailed in the particular specifications. The features and functions shall include:

(a) Next generation firewall
(b) Identity Awareness (identity services for identity-based firewall policy)
(c) IPsec VPN
(d) Intrusion Prevention System (IPS)
(e) Advanced Networking & Clustering for optimum performance and high availability (QoS prioritisation, load sharing and balancing, redundancy etc.)
(f) Mobile access (Secure SSL VPN access, two-factor authentication, Device/end-user pairing etc) for safe remote access from mobile devices
(g) Application control for SCADA/ICS protocols and devices with visibility to a minimum of the following protocols
   (i) IEC-60870-5-104
   (ii) IEC 60870-6 (ICCP)
   (iii) IEC 61850
   (iv) Modbus
   (v) OPC
   (vi) Profinet
   (vii) S7 (Siemens)

5.2.10.3.5 Three (3) years software support for the industrial grade cybersecurity appliance software to be provided

5.2.10.3.6 One (1) cybersecurity management server with perpetual license. The cyber security server shall be installed as a virtual machine to one of the VM host servers. The cyber security server shall meet the requirements detailed in the particular specifications.

5.2.10.4 **Network Management System**

5.2.10.4.1 One (1) Solar Winds Orion Network Performance monitoring for 2000 elements (SL 2000) server and at least five concurrent web clients perpetual license Inclusive of all NPM features as detailed in the particular specification
5.2.10.4.2 Three (3) year software support for Solar Winds Orion Network Performance monitoring

5.2.10.4.3 One (1) Solar Winds Orion Server & Application Monitor (SAM) for 300 monitors (AL 300) inclusive of all features and at least five concurrent web clients, perpetual license Inclusive of all SAM features as detailed in the particular specification

5.2.10.4.4 Three (3) year software support for Solar Winds Orion Server & Application Monitor (SAM)

5.2.10.5 Industrial PC (data acquisition servers)

5.2.10.5.1 Fourteen (14) sets of 64-bit Windows 2016 server standard edition with perpetual license (OEM or FPP or Volume) each with 5 user CALS, two virtual machines and 16 core licenses (4 core server). Bidder to license all the cores in their offered industrial PC. Licensed windows server 2016 shall be pre-installed into each of the fourteen (14) industrial PC’s as virtual machines. Bidder to note that some licenses may be downgraded to windows 2012 R2 by the procuring entity if required prior to delivery. While pricing bidder to quote the higher of the two (windows 2016/windows 2012 R2)

5.2.10.5.2 VMware ESXi 6 (latest hardware compatible version) 64-bit hypervisor to be installed in all the fourteen industrial PC. Hypervisor to be compatible with Microsoft windows 2016 and windows 2012 R2 server.

5.2.10.5.3 Fourteen (14) sets of Microsoft Windows 10 Enterprise IOT LTSB 2016 with perpetual licenses (OEM or FPP or Volume) to be supplied and installed in each of the fourteen industrial PC’s as a virtual machine.

5.2.10.6 Work stations, Thin Clients and Industrial panel PC

5.2.10.6.1 Two (2) 64-bit Windows 10 pro for workstations licensed for all the processors/cores with OEM/other Microsoft perpetual license Pre-installed into each workstation.

5.2.10.6.2 Twenty-six (26) Microsoft Windows 10 Enterprise IOT LTSB 2016 with OEM perpetual license Pre-installed into each operator workstation thin client PC

5.2.10.6.3 Thirty-four (34) 64-bit Windows 10 Enterprise IOT LTSB 2016 with OEM perpetual license Pre-installed (by OEM) into each touch screen panel industrial PC.

5.2.10.7 Engineering Laptops

5.2.10.7.1 Four (4) Latest 64-bit Windows operating system pro version (win10 pro or later) with OEM perpetual license Pre-installed into each laptop.
5.2.10.7.2 Four (4) Latest 64-bit Microsoft Office pro version (office 2016 or later) with perpetual license pre-installed into each laptop.
5.2.10.7.3 Four (4) Latest edition 64-bit VMware Workstation Pro (15 or higher) with perpetual license pre-installed into each laptop.
5.2.10.7.4 Four (4) Latest edition Latest VMware vSphere client pre-installed into each laptop.
5.2.10.7.5 Four (4) Latest edition VMware vCenter converter client and server licensed pre-installed to each laptop.
5.2.10.7.6 Two (2) 64-bit Microsoft windows 2016 server standard edition with volume perpetual license each with 5 user CALS,2VM's & 16 core license (standard license) to be installed as virtual machines into two of the laptops using VMware workstation pro for testing and configuration purposes.

5.2.10.8 **Ethernet Switches**

5.2.10.8.1 Four (4) Cisco Smart NET licenses for three (3) year Support and the latest compatible Cisco IOS to be installed and configured into the four ethernet Cisco switches.

5.2.10.9 **Other**

5.2.10.9.1 Software necessary hardware basic functions such as device drivers, OEM monitoring and configuration software (especially for servers), BIOS etc shall be supplied, installed and configured by the contractor at no extra cost.

5.2.10.9.2 Other devices not included above such as
- Rack mount integrated LCD console
- Industrial ethernet switch
- PTP grandmaster clock and time server
- DCF77 Time code Output converter
- Industrial touch monitor
- KVM switches
- Digital power & energy meter

(b) Shall be supplied with software/firmware necessary to carry out the device functions.
(c) The devices shall also be configured for their respective normal functionality by the contractor based on tender specifications, procuring entity SCADA architecture and OEM specifications.
(d) Software required to configure the above devices shall be supplied licensed (perpetual) and installed into two engineering laptops.

5.2.10.9.3 All software configurable devices in scope of supply shall be supplied with licensed and configured software/firmware necessary for full functionality of
the device irrespective of whether this has been specified in the software scope of supply or not.

5.2.11 OTHER SERVICES SCOPE OF SUPPLY

5.2.11.1 Training

5.2.11.1.1 Bidder offer factory training prior to FAT and site training after delivery of equipment to site as detailed in particular specifications

5.2.11.1.2 Factory training shall be carried out for a minimum of five days to at least five procuring entity staff at each location that FAT shall be carried out

5.2.11.1.3 Site training shall be undertaken by a minimum fifteen procuring entity staff for a minimum of the following duration

(a) Hardware components minimum of five (5) days
(b) Software components minimum of ten (10) days
(c) Cyber security minimum of five (5) days
(d) Network management system minimum of three (3) days

5.2.11.1.4 Site training shall be carried out at procuring entity facilities

5.2.11.1.5 By the end of the site training all topics detailed in the particular technical specification and all other relevant topics MUST be covered

5.2.11.1.6 Contractor shall be wholly responsible for accommodation, transportation and any other required service by their personnel while offering site training

5.2.11.2 Commissioning Support

5.2.11.2.1 After installation of the equipment (by the procuring entity) the procuring entity shall invite the contractor to come and support the procuring entity during commissioning and deployment of the equipment/systems.

5.2.11.2.2 Commissioning support shall be for services offered by contractors’ personnel physically present at site and not online support

5.2.11.2.3 Scope of Commissioning support shall be as detailed in particular specifications and shall be offered by personnel meeting requirements in the particular specifications

5.2.11.2.4 Duration for Initial Commissioning support

(a) Minimum of five working days for Kamburu RCC (servers & related infrastructure) commissioning

(b) Minimum of three working days for LCC equipment (industrial grade equipment) in one station in the seven forks area.
(c) The duration of commissioning and support for NMS and cyber security services shall be set out by the contractor, however enough time shall be allocated for these works. At minimum contractor personnel shall be at site for seven working days to deploy these services

5.2.11.2.5 The contractor shall send personnel for further support after the initial commissioning support for a maximum of thirty expert man days (ten days for three experts or thirty days for a single expert or equivalent) if called upon to do so by the procuring entity to support any other station within seven forks or Kamburu RCC. The days shall not necessarily be concurrent and will depend on procuring entity needs. The bidder shall cost at least thirty expert man days for extra support. The procuring entity may ask assistance for a single day or more than a day for a single expert or more than one expert.

5.2.11.2.6 Contractor shall as much as possible engage local/Kenyan personnel or personnel based in Kenya to provide the commissioning support. International contractors shall as much as possible subcontract these services to local companies which meet qualification given in the particular specifications.

5.2.11.2.7 Contractor shall be wholly responsible for accommodation, transportation and any other required service by their personnel while offering commissioning support. Procuring entity shall not offer accommodation to contractor staff in seven forks, there are good hotels near seven forks plants.

5.2.11.3 Online Support

5.2.11.3.1 Contractor shall offer online support to procuring entity for a period of at least two years from the date of equipment arrival at site.

5.2.11.3.2 Online support in this scope shall be offered directly by the contractor or by the contractor appointed and paid for agents. It shall cover all the equipment and systems in scope of supply

5.2.11.3.3 Online support shall include services/assistance offered to procuring entity in order to enable it to mount, install, configure, deploy, trouble shoot or maintain equipment or systems in scope of supply of this tender

5.2.11.3.4 Online support shall be offered for a minimum of the following medium:
   (a) Telephone, 8am–5pm EAT
   (b) Email, 24hrs, with a response given within 8hrs of receiving the email
   (c) Video telephone/chat, 8am–5pm EAT
   (d) Online/web meeting e.g. zoom within a day notice, 8am–5pm EAT
(e) Remote desktop control & support e.g. team viewer, within a day notice, 8am–5pm EAT.

(f) Any other method agreed upon after contract award

5.2.11.3.5 Software support from the software developer shall not be part of the online support in this scope and shall be offered as part of the software. Software support shall be offered for a minimum of three years as detailed in the software scope of supply. Software support shall be offered directly to the procuring entity from the software developer as per the terms of the software license.
5.3  GENERAL TECHNICAL SPECIFICATIONS

5.3.1  STANDARDS

5.3.1.1 Ratings, characteristics, tests and test procedures, etc. for the electrical equipment encompassed by this Specification shall comply with the provisions and requirements of British standards institute (BS) and International Electro-Technical Commission (IEC) standards or International Electrical & Electronic Engineers – IEEE unless otherwise expressly stated in Particular Technical Specifications.

5.3.1.2 Where the BS or IE or IEEE standards do not fully cover all provisions and requirements for the design, construction, testing, etc. and for equipment and components that are not covered by IEC recommendations. The European Committee for Standardization (EN) standards, rules of CEE (International Commission for the approval of electrical equipment), the standards of CENELEC (Comité Europeen de Normalisation Electrotechnique) and other recognised national/international standards LISTED BELOW shall be applied. The other recognized national and international standards are:

5.3.1.2.1 International standardization organization – ISO
5.3.1.2.2 Telecommunications Industry Association (TIA)
5.3.1.2.3 International Telecommunication Union (ITU)
5.3.1.2.4 German – DIN
5.3.1.2.5 American National Standards Institute - ANSI
5.3.1.2.6 American Society of Mechanical Engineers – ASME
5.3.1.2.7 American Society for Testing and Materials - ASTM
5.3.1.2.8 International Society of Automation - ISA

5.3.1.3 Equipment and works shall conform to standards of the bodies indicated clause 5.3.1.1 and 5.3.1.2 ONLY no other standards from other bodies shall be allowed.

5.3.1.4 The latest revision or edition in effect at the time of Bid Invitation shall apply for all standards used or stated in this tender document. Where references are given to numbers in the old numbering scheme from IEC it shall be taken as to be the equivalent number in the new five-digit number scheme.

5.3.1.5 The Tenderer shall state the Precise Standard, complete with identification number, to which the various equipment and materials are manufactured. The tender documents do not contain a full list of all standards to be used; the contractor shall give the precise standard which the equipment and work shall conform to.
5.3.2 GENERAL MATERIALS AND EQUIPMENT SPECIFICATIONS

5.3.2.1 General

5.3.2.1.1 The equipment shall withstand without permanent weakening or deformation from short circuit current within the rating of the apparatus (including those due to faulty synchronising) as well as normal atmospheric over voltages taking into account the use of lightning arresters. Special considerations shall be given to pressure rises by short circuits and fire risk. All material and equipment shall be designed and arranged so that over pressure will be relieved in a safe direction and so that fire risk is minimised, and consequences of a fire reduced.

5.3.2.1.2 All plastic material used in boxes, panels and boards shall be halogen free and self-extinguishable.

5.3.2.1.3 The contract supplies shall be designed to facilitate inspection, cleaning and repairs and for operation, in which continuity of service is the first consideration.

5.3.2.1.4 All conductors’ current carrying parts must be dimensioned with ample cross sections so that temperatures are kept within limits in operation and under short circuits. Temperature rises on all equipment shall be kept within limits set in IEC standards provided nothing else is specified. For all current carrying parts the permissible short circuit duration shall be at least 3 second. All electrical connections shall be secured by bolts or set screws of ample size, fitted with locknuts or lock washers of approved types. The equipment shall as far as possible be factory mounted with internal cables and internal equipment installed before shipment. Plug-in components can be shipped separately.

5.3.2.1.5 Equipment for use in live panels shall not be flammable and shall be self-extinguishable and resistant to flame propagation.

5.3.2.1.6 Equipment for use outdoors or in wet or damp rooms shall be constructed so that water runs off. It shall also have devices draining any inside condensation that may form. Axial bearings on such equipment must be equipped with durable sealing preventing water to ingress.

5.3.2.1.7 Cast iron shall not be used for chambers of oil-filled apparatus or for any part of the equipment that is in tension or subject to impact stresses. Exception is made where it can be shown that service experience has been satisfactory with the grade of cast iron and the duty proposed.

5.3.2.1.8 Materials shall be new; the best quality of their respective kinds and such as is usual and suitable for work of like character. All materials shall comply with the
latest issues of the specified standard unless otherwise specified or permitted by the Employer.

5.3.2.1.9 Iron and Steel are generally to be painted or galvanized as appropriate. Indoor parts may alternatively have chromium or copper-nickel plates or other approved protective finish.

5.3.2.1.10 Workmanship shall be of the highest class throughout to ensure reliable and vibrations free operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.

5.3.2.1.11 All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined, and all castings shall be spot faced for nuts. All machined finished shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes. All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by the Employer.

5.3.2.1.12 Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

5.3.2.2 **Electrical Equipment Materials**

5.3.2.2.1 All materials supplied under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified. They shall withstand the variations of temperature and atmospheric conditions arising under working conditions (including start and stop) without distortion, deterioration or undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed. The equipment shall be designed for a lifetime of 25 years.

5.3.2.2.2 No welding, filling or plugging of defective parts shall be permitted.

5.3.2.2.3 Materials that are susceptible to mould growth under tropical conditions shall be treated to exclude moisture and prevent growth of mould after all machining has been carried out.
5.3.2.2.4 Cables and bus bars shall be of the highest quality copper. Aluminium conductors shall not be allowed unless specified in particular specifications for a particular component only.

5.3.2.2.5 Small iron and steel parts (other than rustles steel) of all instruments and electrical equipment, the cores of electromagnets and the metal parts of relays and mechanisms shall be treated in an appropriate manner to prevent rusting.

5.3.2.2.6 Copper and aluminium used as electrical conductors shall be of the electrolytic type and comply with the respective DIN or ASTM Standards.

5.3.2.3 **Bolts, Studs, Nuts, Screws, Washers, etc.**

5.3.2.3.1 All bolts, studs, nuts, etc., shall have a standard metric threading and conform to the relevant standards as regards shape and tolerance. They shall be of Strength Class 8.8 and marked accordingly.

5.3.2.3.2 All bolts, studs, nuts, washers, screws, etc., used outdoor or in wet or moist environment shall be made of stainless steel.

5.3.2.3.3 All bolts and nuts shall be hexagonal, either normally or of the round head socket type and secured in an approved manner against becoming loose during operation. The Contractor shall supply the net quantities plus 5% of all permanent bolts, screws and other similar items and materials required for installation of the works at the site. Any such rivets, bolts, screws, etc. which are surplus after the installation of the equipment has been completed shall become spare parts and shall be wrapped, marked and handed over to the Employer.

5.3.2.3.4 Taper pins shall have threaded stems with nuts where dismantling of the pins is likely to be required.

5.3.2.3.5 Bolts shall not protrude more than 10 mm beyond the nut but not less than three full threads.

5.3.2.4 **Surface Treatment and Painting of Panels, Support Structures & Electrical equipment**

5.3.2.4.1 Panels, boards, cubicles and cabinets, for indoor use in dry rooms shall have interior surfaces painted with at least one priming and one finishing coat of anti-corrosion paint. Exterior surfaces shall be adequately treated to be substantially corrosion resistant, with one priming coat, and two finishing coats.

5.3.2.4.2 Outdoor installations and indoor installations in wet and damp rooms shall at least have one priming coat and two layers of paint on zinc powder basis applied after perfect cleaning.

5.3.2.4.3 Structural supports outdoor and in wet or moist rooms and parts that cannot be readily painted, shall be hot-dip galvanised. All galvanising shall be in
accordance with BS 729 or other internationally approved standards. Steel below ground shall in addition to galvanising be protected with Bitumen or a substance of similar quality.

5.3.2.4.4 The humid and tropical conditions shall be taken into account on selection of the paints and painting procedure.

5.3.2.4.5 All External surfaces panels, cubicles, cabinets, structural supports etc. shall be painted using RAL7035 colour

5.3.2.5 Insulating Liquids

5.3.2.5.1 All electrical equipment requiring insulating oil or other insulating liquids shall be furnished with the first filling including flushing, if required. An excess of 10% of the net amount of oil or liquid required for each component shall also be furnished by the Contractor as spare.

5.3.2.5.2 The Contractor shall endeavour to employ, as far as practicable, one type and make of insulating oil only for all the electrical equipment.

5.3.2.6 Sulphur hexafluoride gas (SF6)

5.3.2.6.1 The SF6 gas shall comply with the requirements of IEC 60376. In addition to the quantity of gas required to fill the equipment supplied, 20% shall be supplied as spare.

5.3.2.6.2 The high-pressure cylinders for shipment and storage of the SF6 gas shall comply with the applicable national regulations. All the necessary pipes, couplings, flexible tubes and valves for coupling to the switchgear for filling or evacuating all the gases to be used, with all necessary instructions for the storage of this equipment, shall be provided.

5.3.2.7 Nameplates and signs

5.3.2.7.1 All nameplates and signs shall be made of non-corrosive weatherproof material such as trafolyte, aluminium or stainless steel.

5.3.2.7.2 Marking shall be in corrosion resistant material with engraved and coloured lettering. All equipment shall be marked in accordance with standards and local practice. The Contractor must mark all components in a clear and unambiguous way so that it can be related to the documentation.
5.3.2.7.3 Letters shall be white and engraved on black background. For aluminium and steel signs black letters on metallic background shall be used. For warning signs, red background shall be used.

5.3.2.7.4 All panels, cubicles, switchboards, switchgear compartments, outdoor equipment and structures and all devices & equipment mounted in the panels shall be labelled with name plates. All operating mechanisms as pushbuttons, switches and handles must be marked in a precise way and necessary warning signs must be supplied.

5.3.2.8 Equipment Working Stress and Reliability

5.3.2.8.1 The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations, which might adversely affect the operation of the equipment.

5.3.2.8.2 Mechanisms shall be constructed to avoid sticking due to rust or corrosion. The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner with materials best suited to their respective purpose and generally in accordance with up-to-date recognized standards of good practice.

5.3.2.8.3 The equipment shall be designed to cope with 0.20g seismic acceleration on their centres of gravity.

5.3.2.8.4 All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of vermin and dust and accidental contact with electrically energized or moving parts.

5.3.2.8.5 Panels and switch boards shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to be obtained in a tropical climate.

5.3.2.9 Degree of Protection

5.3.2.9.1 Enclosures for electrical equipment shall offer the following degree of protection at minimum (ref. IEC 60034, IEC 60059, IEC 60529 and IEC 60947) where it's not stated in the particular specifications:

(a) Motors/Motor Terminal boxes IP 54/IP 65
(b) Dry Transformers (indoor) IP 2x
(c) Limit switches IP 65
(d) Indoor switches IP 5x
(e) Outdoor switches IP 65
(f) Low voltage switchgear and control cabinets:
(i) Indoor
(ii) Outdoor
(iii) Junction boxes
(g) Light fittings
   (i) Outdoor and wet areas
   (ii) Indoor

5.3.2.9.2 Printed circuit boards **SHALL NOT** be mounted on the panels. All printed circuit boards shall be contained in enclosures with an ingress protection of at least IP30 with terminal blocks and ports on the enclosures for interface.

5.3.2.10 **Locking Devices and Padlocks**

5.3.2.10.1 All panels, cubicles, switchboards, switchgear compartments and Facilities for applying safety isolation i.e. circuit breaker operating mechanisms, disconnectors & switches operating handles, control switches, bus bar shutters etc. shall be provided with locks. Locks with at least three keys will be provided. Padlocks will only be used where other locks are not appropriate.

5.3.2.10.2 Three keys with labelled trafolyte/polyamide66 holder shall be provided for each lock, key operated devices and padlocks.

5.3.3 **AUXILIARY POWER SUPPLY EQUIPMENT**

Auxiliary power for the purposes of this clause shall mean power supply powering plant control, metering and protection devices.

5.3.3.1 **General Auxiliary Power Supply Requirement**

5.3.3.1.1 The electricity supplies for auxiliary supply will be as follows:
   (a) 415 volts 3-phase 50 Hz 4-wire for heavy power application such as motors.
   (b) 240 volts’ single phase 50 Hz for light power application such as lighting, indication, anti-condensation heaters and computers.
   (c) 110 volts DC for control, metering, indication and protection devices and all power circuit breakers closing, tripping and spring charging supplies.
   (d) 110 volts DC for power operated isolators and earthing switches.
   (e) 24V DC for electronics supply where specified.
5.3.3.1.2 Alternating Current (AC)

(a) All mains auxiliary supplies shall be switched and protected with a circuit breaker. Double-pole circuit breakers shall be used to break single-phase ac mains supplies. For multi-phase supplies, each phase shall be switched simultaneously.

(b) Miniature circuit breakers shall be used in auxiliary AC power circuits rated 63 amps and below unless otherwise stated in particular specifications. They shall be approved as circuit breakers and have a breaking capacity sufficient to break the short circuit at the place of use (i.e. no upstream backup fuses for reduction of fault level shall be necessary).

(c) Except where prior approval is obtained, wires external to the equipment shall be colour coded as stated elsewhere this specification.

5.3.3.1.3 Direct Current (DC)

5.3.3.1.4 All DC circuits shall be switched and protected by appropriately rated circuit breakers, the circuit breakers must be approved for the relevant DC voltage and current, fuses to be used for ratings of 1A and below only unless otherwise specified in the particular specifications.

(a) Double pole circuit breakers shall be used for switching and protection of all DC supply circuits rated above 1A, they shall be rated appropriately to break DC short circuit without the necessity of upstream backup fuses.

(b) Where found necessary, backup fuses shall be used to prevent tripping of main DC supplies.

(c) If electronic equipment or system require the use of local internal batteries approval must be obtained. Where approval is given, batteries used inside equipment shall be: totally sealed, leak-proof type, have no possibility of explosion even at ambient temperature above 40°C, available in the local market and rated below 5V. Use of internal batteries shall be avoided unless where specified.

(d) Control equipment supplied under this contract shall be rated for direct use of 110VDC without external power supply units. Where this is not possible or where appropriate 24VDC auxiliary supply shall be used. Other than 110VDC, only 24VDC shall be allowed for auxiliary DC supply to control, metering and protection equipment.

5.3.3.2 Fuses
5.3.3.2.1 Carriers and bases for fuses and links shall be in accordance with IEC 269 standard and colour coded to permit identification of the circuit rating.

5.3.3.2.2 The contacts of the fixed portion of the fuse or link shall be shrouded so that accidental contact with live metal cannot be made when the moving portion is withdrawn.

5.3.3.2.3 Main supply fuse links shall, unless otherwise specified, be of the high rupturing capacity cartridge type. Where fuse carriers are mounted vertically, the incoming (supply) circuit shall be connected to the top terminals. Where fuses are used, the Contractor shall ensure that proper discrimination between main and sub-circuits is maintained.

5.3.3.2.4 Where LV power fuses above 63 amps are specified, they shall be of high rupturing capacity cartridge, type NH gl, according to DIN VDE 0636 and IEC 60269. All fuse bases shall have a load switching capacity and a thermal rating equal to the rating of the largest fuse it can accommodate. Fuse replacement shall be possible without use of special tools and with IP 20 protection against live parts.

5.3.3.3 **Miniature Circuit Breakers, MCB**

5.3.3.3.1 Miniature circuit breakers shall be designed and tested in accordance with IEC 60947 and supplementary requirements of this specification.

5.3.3.3.2 They shall be suitably rated for both the continuous and short circuit loadings of the circuits they are protecting under all service and atmospheric conditions stated in the specification and ensure that correct discrimination is maintained between main and sub-circuits.

5.3.3.3.3 Where circuit breakers are used in circuits containing inductive loads, e.g. operating coils, it is essential that they are suitable for satisfactory operation in the circuit in which they are used, i.e. account is taken of the circuit time constant.

5.3.3.3.4 All MCB’s shall be provided with two auxiliary contact(s) for remote indication of circuit breaker operation and interlocking purposes.

5.3.3.3.5 Means shall be provided to prevent the circuit breakers being inadvertently switched to the ‘OFF’ position.

5.3.3.3.6 Circuit breakers shall be mounted in such a manner so as to give easily visible indication of breaker position and shall be grouped and spaced.

5.3.3.4 **Motor Protection Circuit breaker, MPCB**

MPCB’s shall be special kind of MCCB’s for three phase loads rated below 100A. They shall meet the following requirements.
5.3.3.4.1 Designed for motor and other three phase loads protection. They shall be used for protection of all three phase control circuits/supplies such as such as VT inputs and outputs, voltage monitoring relays input etc.

5.3.3.4.2 The MPCB’s shall be suitably rated for the application, with overload settings as low as 0.1A for control circuits protection.

5.3.3.4.3 Shall have an adjustable overload setting, with a dial on the front side for adjustment. Overload shall be settable from at least 10% to 100% MPCB rating.

5.3.3.4.4 The current ratings given in the specifications take into account that the overload shall be settable from at least 10% to 100%. Overload setting and trip classes shall be computed during design.

5.3.3.5 **Power Supply Units (PSUs)**

5.3.3.5.1 PSUs shall be of approved design and such that they do not impose parasitic or harmonic voltages on the station battery system or electronic equipment.

5.3.3.5.2 Protection circuits incorporated into PSUs shall be such that any overload of the output or short circuit current does not damage any components within the PSU.

5.3.3.5.3 PSUs shall incorporate over-voltage and overcurrent protection devices to protect the components that comprise the output load.

5.3.3.5.4 All PSU’s shall have at least one SPDT alarm contact to annunciate failure of the PSU.

5.3.3.6 **Electrical Sockets**

5.3.3.6.1 Single phase electrical sockets installed for lamps, hand tools, measuring equipment etc., shall be the British standard (IEC Type G) type with 3 square pin sockets or euro type (CEE 7/3) socket with earth connection as detailed in particular specification.

5.3.3.6.2 All sockets shall be rated for at least 16A (lower rating shall not be used).

5.3.3.6.3 Three phase sockets shall be according IEC 60309 (CEE type).

5.3.3.6.4 Contractor shall use sockets available in the local market as much as possible.

5.3.4 **CONTROL DEVICES GENERAL REQUIREMENTS**

5.3.4.1 **Instruments/Transducers**

5.3.4.1.1 General Requirements
5.3.4.1.2 Pressure sensors and transmitters shall be of corrosion proof material, degree of protection IP 54, vibration class I (ISO 2372). Their scale shall indicate bar. The measuring pipe shall be equipped with stop chock. If the indicator is exposed to vibration it shall be filled with damping liquid (glycerine).

5.3.4.1.3 Limit switches for pressure, temperature and flow (even if combined with the indicators) shall be of class 1, conforming to IEC 60536 without noticeable hysteresis. Where more than one limit is required each limit shall be independently settable. Set points shall be easily readable.

5.3.4.1.4 Limit switches not mounted in enclosures shall be of the proximity type without need for separate power supply and equipped with light emitting diodes to indicate position where necessary.

5.3.4.1.5 Flow meters shall be graded in litres/s or m³/s from zero to 150% above required value. They shall be electronic without moving mechanical parts.

5.3.4.1.6 Resistance temperature detectors (RTD)

5.3.4.1.7 They shall be industrial grade PT 100 type protected to suit the environment where there are to be used.

5.3.4.1.8 They shall conform to the IEC 60751: 2008 Standard

5.3.4.1.9 They shall meet accuracy class B as per IEC 60751 i.e Class B = \( \pm (0.30 + 0.005 \times t) \) for (-50 to 500°C). Accuracy of \( \pm 0.8^\circ C \) at 100°C

5.3.4.1.10 Shall have an operating range of at least \(-200^\circ C\) to \(+ 500^\circ C\)

5.3.4.1.11 Shall be wire wound with good vibration resistance

5.3.4.1.12 They shall either be four wire or three wire connection type. Two wire types SHALL NOT be accepted for any application

5.3.4.2 Panel Indication meters

5.3.4.2.1 General requirements

(a) All Panel mounted instruments and meters shall be flush-mounted, back-connected, dust-proof and heavy-duty. They shall have a removable cover, either transparent or with a transparent window.

(b) Panel indication shall be of digital type unless where specified in particular specifications.

(c) Analogue panel indication meters

Where Analogue panel meters are used, they shall have at minimum the following features:

(i) scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings,

(ii) shall be have a clear transparent non-reflective window and clearly readable long scale
(iii) Shall be of accuracy class 1.5 or better, the maximum error shall be not more than one and a half (1.5) percent of full-scale range.

(iv) Their cut out shall be DIN standard 1/4DIN, or 1/8 DIN

5.3.4.2.2 Digital Panel Indication Meters

(a) There shall be four types digital panel meters depending on inputs, these are:

(b) Digital indication meter for Instrument/process signals with a 4-20mA DC current input

(c) Digital DC voltmeter/Ammeter with a DC input voltage whose range is selectable and an external shunt for DC current ammeter

(d) Digital AC ammeter with a AC current input from a CT

(e) Digital AC voltmeter with a AC voltage input (phase-phase or phase-neutral)

(f) The meters shall site programmable/configurable for scaling, range set up etc. They shall have at least three buttons on the front for this purpose.

(g) Indication meters shall meet or exceed accuracy Class 1, according to IEC 62053-11.

(h) Display MUST be 5-digit LED with characters sized at least 14mm for all digital meters

(i) They shall be panel mounted, flush mounted on the front of the panel with connections from the rear.

(j) They shall have buttons and menu for configuring their parameters such as

   (i) Input range
   (ii) Output range
   (iii) VT/CT ratio
   (iv) Scaling factor

(k) They shall meet the following minimum specifications

   **(i) Inputs and accuracy range**

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Resolution</th>
<th>Input Resistance</th>
<th>Error at 25°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Current</td>
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<tr>
<td>for digital</td>
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<td>Instrument/process</td>
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<td>signals indication</td>
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<td>±20.000 mA</td>
<td>1.0 µA</td>
<td>10 Ω</td>
<td>0.01% FS ± 2 counts</td>
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<tr>
<td>DC Voltage</td>
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<tr>
<td>for digital</td>
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<tr>
<td>DC voltmeter/Ammeter</td>
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</tr>
<tr>
<td>±200.00 mV</td>
<td>10 µV</td>
<td>1 GΩ</td>
<td>0.01% FS ± 2 counts</td>
</tr>
<tr>
<td>±20.000 V</td>
<td>1 mV</td>
<td>10 MΩ</td>
<td>0.01% FS ± 2 counts</td>
</tr>
<tr>
<td>±300.00 V</td>
<td>10 mV</td>
<td>10 MΩ</td>
<td>± 0.4 V</td>
</tr>
</tbody>
</table>

AC Current for digital AC ammeters
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

| 0-5.000 A | 1 mA | 0.01 Ω | ± 20 mA |
| AC Voltage for digital AC voltmeter |
| 0-300.0 V | 100 mV | 1 MΩ | ± 0.8 V |
| 0-600.0 V | 100 mV | 1 MΩ | ± 0.8 V |

(ii) Display

Readout: 5 LED digits, 7-segment, 14.2 mm (.56”), red or green from -999999 to 999999

Range: Minus sign, decimal point, 2 red LED lamps (configurable)

Display update rate: 3 per second

(iii) A-to-D Conversion

A-to-D rate: >50 per second

Output update rate:
- Signals > 50 Hz: >50 per second
- Signals > 3 to 50 Hz: Signal frequency
- Signals > DC to 3 Hz: 3 per second

(iv) Maximum input Signal

Max applied voltage: 600 VAC for 20, 200 and 300 V ranges, 125 V AC for other ranges

Current protection: 8x for 20 mA, 1x for 5 A

(v) Power supply

Voltage range: 85–264 VAC or 90–300 VDC

nominal: 110VDC ± 20%,

Consumption: less than 3VA

(vi) Excitation Output (if specified in particular specifications)

level: 24 VDC ± 5%, 50 mA

Output isolation: 50 VDC to meter ground

(vii) Analog Output (if specified in particular specifications)

Output levels: 4–20 mA, 0–20 mA, 0–10V, -10 to +10V (jumper selectable)

Scaling: Zero and full scale adjustable from -999999 to +999999

Resolution: 16 bits (0.0015% of full scale)

Isolation: 250V RMS working, 2.3 kV RMS per 1 min test
(viii) Relay Outputs (if specified in particular specifications)

- Relay types: Two independent SPDT relays
- Current ratings: 8A at 250 VAC / 24 VDC
- Output common: Isolated commons for each SPDT relay
- Isolation: 250V RMS working, 2.3 kV RMS per 1 min test

(ix) Serial Data I/O (if specified in particular specifications)

- Interface: RS485, RJ45 or terminal block connection.
- Protocols: Modbus RTU
- Data rates: 300 to 19200 baud
- Isolation: 250V RMS working, 2.3 kV RMS per 1 min test

(x) Environmental

- Operating temperature: 0°C to 55°C
- Storage temperature: -40°C to 85°C
- Relative humidity: 95% at 40°C, non-condensing
- Ingress Protection: IP65

(xi) Dimensions

- Panel Cut-out: 1/8 DIN 92mm X 45mm OR 1/4 DIN 92mm X 92mm depending on particular specifications or design requirement
- Front dimensions: 96mm X 48mm OR 96mm X 48 mm depending on particular specifications or design requirement
- Device overall depth: less than 125mm without the connections

(xii) Connections

- Type: Screw type
- Wire size: 2X2.5mm2

5.3.4.3 Indicating lamps and Push buttons

5.3.4.3.1 All status and position indication lamps shall be of the light emitting diode type and be replaceable without use of soldering or special tools. A switch for lamp test shall be put in all panels, neighbouring panels can be grouped together with one test switch.

5.3.4.3.2 All indication contacts shall be galvanic isolated and potential free.
5.3.4.3.3 Indicating lamp assemblies shall be of the switchboard type, insulated for 110 V DC or 24V DC service as specified, with appropriately coloured lens and integrally mounted resistors for 110- or 24-volt service. The lens shall be made of a material, which will not be softened by the heat from the lamps.

5.3.4.3.4 For the Circuit Breakers, isolators and motors status indications, Red indicating lamps shall be used for “ON/CLOSED” position, green lamps for “OFF/OPEN” position Indication and Amber for Transition.

5.3.4.3.5 For alarms/warnings, yellow indicating lights shall be used while for trips/faults, red indicating lamps shall be used.

5.3.4.3.6 All semaphores SHALL be of LED type.

5.3.4.3.7 Emergency push buttons shall be protected from accidental operation by a glass cover.

5.3.4.3.8 Emergency push button shall remain latched when operated until reset.Resetting shall be done by twisting or rotating the button.

5.3.4.3.9 Illuminated pushbuttons shall consist of a command push button and a status LED lamp. The LED lamp shall indicate the status of the device/primary circuit commanded by the push button.

5.3.4.3.10 Discrepancy switches shall be used for operation of switchgear, they shall have the following specifications:
(a) They shall be operated by Push, turn and control
(b) They shall have an integrated LED for position indication
(c) Shall be rated for 110V DC or 24 V DC depending on application
(d) Shall have a big knob made of transparent polycarbonate completely illuminated by a coloured LED inside.
(e) LED shall be lit depending on the position of the switch and the controlled device
(f) Each discrepancy switch shall at minimum have four (4) SPDT contacts

5.3.4.4 Instrument Transformers General Requirements

5.3.4.4.1 Where new instrument transformers are required the bidder shall include them in their bid offer.

5.3.4.4.2 All instrument transformers to be supplied shall satisfy all IEC requirements on testing and design. Type test reports shall be provided with the bid offer. Routine tests shall be carried out by the contractor and results sent to the employer prior to shipment.

5.3.4.4.3 Burden for the current transformers shall be arrived at during design stage in order to ensure safe and accurate operation of connected meters and to prevent
early saturation of protection CT’s. CT Burden indicated in the tender documents shall be used for during bidding for cost estimation etc.

5.3.5 **AUXILIARY RELAYS**

5.3.5.1 **General requirements**

5.3.5.1.1 Resetting of relays and contactors MUST be possible without dismantling of any covers and without risk for electrical shock. All contactors and relays used in DC circuits must be approved for the relevant DC voltage and current.

5.3.5.2 **Lockout trip Relays**

5.3.5.2.1 Lock out trip relay shall be a high-speed trip relay with: high burden, latching contacts, front panel hand reset button, reset coil for remote electrical reset and Independent hand reset flag. Trip functions specified in the particular specifications shall be wired to energize this relay.

5.3.5.2.2 Relays shall be of the bi-stable type, well supported to avoid malfunctioning. A reset button shall be wired to put the relay to normal position after the latched signals from the protection schemes have been reset.

5.3.5.2.3 Relay shall be a single unit (without a separate base) it shall have a heavy-duty metallic cover

5.3.5.2.4 Shall be panel mounted, flush mounted on the front of the panel with connections from the rear.

5.3.5.2.5 Relays shall have maximum operating time of 10milliseconds.

5.3.5.2.6 Relays operating coil shall have a minimum Operating Current of 100MA and Operating Voltage Range Between 72VDC and 130VDC

5.3.5.2.7 Surge suppressor devices shall be provided across relays coils and contacts as necessary

5.3.5.2.8 Relay shall have a mechanical flag (similar to electromechanical relays flags) indication with red colour for tripped which shall be clearly visible and shall require hand reset.

5.3.5.2.9 Relays shall have heavy duty, voltage free contacts able to withstand continuous current of 25A at 120VDC and an insulation resistance of 1kVrms for 60s across normally open contacts

5.3.5.2.10 Relays shall have either 5,10 or 20 SPST contacts

5.3.5.2.11 Relays latched contacts shall not be able to reset during a failure of auxiliary power supply.
5.3.5.2.12 Manual online testing facility shall be provided for testing without isolation of any circuit from panel TB. Necessary test blocks/plugs shall be flush mounted on the panel near or next to each lockout relay.

5.3.5.2.13 Push button/s shall be installed on the panels for resetting lockout relays

5.3.5.2.14 Relays insulation must comply with IEC 60255-5 standard with a minimum insulation resistance of 2KVRms for 60s between all terminals and earth and 2KVRms for 60s between independent circuits.

5.3.5.2.15 Relays shall also conform to the following standards:
   (a) Vibration: IEC 60255-21-1 Class1
   (b) Shock and bump: IEC 60255-21-2 Class1
   (c) Seismic: IEC 60255-21-3 Class1
   (d) Enclosure: IP5x
   (e) Humidity IEC 60068-2-78
   (f) Temperature IEC 60068-2-1/2

5.3.5.2.16 Trip Lockout relays type tests reports as per IEC 60255 from a third-party reputable testing laboratory certified by the National Standards and Testing Authority (NSTA) or a laboratory accredited to the NSTA shall be submitted

5.3.5.3 Control Contactor Relays

   These relays shall be used for control and tripping purposes
   They MUST meet ALL the following specifications:

5.3.5.3.1 Number Contacts: 4poles 4 SPST OR 8 poles 8 SPST depending on application

5.3.5.3.2 Contacts current rating at 110VDC: At least 3A

5.3.5.3.3 Magnetic coil voltage rating: 24VDC/110VDC with a range of +/ - 20%

5.3.5.3.4 Magnetic coil maximum power rating for closing and holding: 4W

5.3.5.3.5 Structure: Relays shall be a single unit i.e. without a separate base for mounting and shall have a capability to plug an auxiliary unit on top with 4 contacts poles (4 SPST)

5.3.5.3.6 Base unit: Relay base unit shall have four contacts poles (4 SPST) and the operating coil

5.3.5.3.7 Auxiliary plug in unit: relays shall have an auxiliary plug in unit with four contacts poles (4C/O)

5.3.5.3.8 Connection type: screw-type terminals
5.3.5.3.9 Type of connectable conductor cross-section (for auxiliary and control current circuit): at least 2X4mm² solid conductors or 2X2.5mm² stranded cores with bootlace.

5.3.5.3.10 Mounting type: Snap-on mounting on a DIN rail

5.3.5.3.11 Size of relays: S00 (for Siemens)

5.3.5.3.12 Resetting: Relays shall be self-resetting

5.3.5.3.13 Protection class on the front: IP20

5.3.5.3.14 Degree of pollution: 3

5.3.5.3.15 Insulation voltage: 690 V

5.3.5.3.16 Surge voltage resistance: 6kV

5.3.5.3.17 Mechanical service life (switching cycles): at least 30,000,000

5.3.5.3.18 These relays shall be provided with voltage free contacts for operating with associated circuits. The contacts shall be amply rated for their A.C or D.C duty with snap action where possible and magnetic blow – out devices. Surge suppressor devices shall be provided across relays coils and contacts.

5.3.5.4 Coupling/Interfacing relays

5.3.5.4.1 These relays shall be used to isolate two systems at the same voltage or different voltages. Digital inputs and output Signals from and to the plant control system shall be coupled to the new systems via these relays where specified in the particular specifications

5.3.5.4.2 There shall be two types of coupling relays

(a) Highly compact micro-relay modules with 1 SPDT or solid-state micro plug in relays

(b) Miniature interface auxiliary relays modules with 4 SPDT electromechanical plug in relays

5.3.5.4.3 Highly compact micro-relay modules (optocouplers)

(a) Highly compact micro-relay modules shall be used to interface contact outputs or inputs between two systems using different common supply, for circuit isolation or wherever else it may be necessary as per design or particular specification

(b) They shall consist of a power terminal block and a plug-in micro relay

(c) The power terminal block shall have the following general features:

- Integrated filter to protect against interference voltages or currents
- The housing shall be made of Polyamide PA non-reinforced
- Shall permit operating voltages of up to 250VAC
- Shall accommodated a solid state or electromechanical relay
- Permit a continuous current of 10 A
- Safe isolation according to DIN EN 50178 between coil and contact
- Screw connection terminals
- Support wide range of input voltages from 12 V DC to 230 V AC
- Shall have Integrated yellow LED and interference suppression circuit on the input circuit
- Output circuit Protection against polarity reversal and surge protection
- Support conductor cross section of 0.2 mm² ... 4 mm² for solid / stranded connections
- Contact material - AgNi
- Dimensions W / H / D - 6.2 mm / 80 mm / 94 mm or equivalent
- Insulation - input/output 4 kV (50 Hz, 1 min.)
- Ambient temperature (operation) - 20 °C ... 55 °C
- Mechanical service life - min 2 x 10⁷ cycles
- Standards/regulations - IEC 60664, EN 50178, IEC 62103
- DIN rail mounting

(d) Plug-in micro relays (electromechanical) shall have the following general features:
- Typical input current at rated voltage shall be within range of 3-7mA
- Shall have a response time of less than 5ms at rated voltage
- Contact material shall be made of silver nickel AgNi
- The contacts shall be double throw (SPDT)
- Switching voltage up to 250V AC/DC depending on the application
- Power contacts up to 16 A
- High degree of protection IP67
- Safe isolation according to DIN EN 50178 between coil and contact
- Dimensions W / H / D - 5 mm / 28 mm / 15 mm or equivalent
- Insulation - input/output 4 kV (50 Hz, 1 min.)
- Ambient temperature (operation) - 40 °C ... 85 °C
- Mechanical service life - min 2 x 10⁷ cycles
- Standards/regulations - IEC 60664, EN 50178, IEC 62103

(e) Plug-in solid-state relays shall have the following general features:
- Typical input current at rated voltage shall be within range of 3-7mA
- Shall have a typical switch-on time of 20μs at rated voltage
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- Contact material shall be made of silver nickel AgNi
- Switching voltage up to 250V AC/125V DC depending on the application
- Contacts continuous current of up to 5 A
- High degree of protection IP67 and Vibration and shock-resistant
- Dimensions W / H / D - 5 mm / 28 mm / 15 mm or equivalent
- Insulation - input/output 2.5 kV (50 Hz, 1 min.)
- Ambient temperature (operation) - 25 °C ... 60 °C
- Standards/ regulations - IEC 60664, EN 50178, IEC 62103

5.3.5.4.4 Miniature interface auxiliary plug-in relay modules

(a) These relays shall be used for interface circuits where contact multiplication is required and other interfacing functions as per particular specification or design requirements
(b) The relay module shall consist of a plug-in relay, socket and a holder
(c) The relays shall have 4 c/o (4 SPDT) contacts rated 6 A continuous current
(d) Rated coil voltage shall be 110VDC or 24VDC depending on application
(e) Relay shall have gold contacts Cadmium-free
(f) Shall have an integrated LED and freewheeling diode
(g) Shall have Integrated test button for manual actuation and locking of output contacts
(h) Relay Shall have clearly visible mechanical status indication
(i) The socket shall have screw connection terminals.
(j) The relay shall be held in place by a wide thick plastic holder
(k) The Holder shall have Snap-on mounting on DIN rail
(l) The socket shall not be wider than 27mm
(m) Basic ratings:
   (i) **Plug in relay**
      - Rated control supply voltage, Ur: 24VDC or 110VDC
      - Coil Operating voltage: Ur ±20%
      - Coil power consumption: <1W
      - Output circuits:
        - 11-12/14, 21-22/24, 31-32/34, 41-42/44
      - Contact material: AgNi/Au 5 μm
      - Maximum switching voltage: 250 V DC / 250 V AC
      - Contacts rated operational current: ≥6A
Maximum switching (breaking) power \( \geq 1500 \text{ VA} \)
Contact resistance \( \leq 100 \text{ m\ohm} \)
Mechanical lifetime \( > 2 \times 10^7 \text{ switching cycles} \)
Electrical lifetime \( > 10^5 \text{ switching cycles} \)
operating time \( < 16 \text{ms} \)
rated insulation voltage \( > 250 \text{VAC} \)
Rated impulse withstand between coil and contacts \( 2.5 \text{kV AC} \)
between open contacts \( 1.5 \text{kV AC} \)
between c/o (SPDT) contacts \( \geq 2 \text{kV AC} \)
Clearance between coil and contacts \( \geq 1.6 \text{ mm} \)
Creepage distance between coil and contacts \( \geq 3.2 \text{ mm} \)
Degree of protection IP 40
Ambient temperature range -40...+70 °C
Product standard EN 60810-1, EN 60255-23, IEC 61810-7

(ii) **Socket**
Rated current \( \geq 12 \text{A} \)
Degree of protection IP 20 B (EN 60529)
Temperature range -40...+85 °C
Connection type screw connection
Maximum number of wires per connecting terminal 2
Wire size with wire end ferule \( 2 \times 1.5 \text{ mm}^2 \)
Wire size without ferule \( 2 \times 2.5 \text{ mm}^2 \)
Mounting DIN rail (EN 50022)
Socket Material PA 6+GF - V2
contacts Material CuZn33
contact surface \( 5 \mu \text{ tinned} \)
terminals \( 8 \mu \text{ galvanized} \)
combi screw M3 8.8 Steel, 5\mu nickelized
Insulation voltage > 3 kV
Isolation between coil and contacts EN 61984
Clearance and creepage distance EN 61984

5.3.5.5 **Trip circuit/coil supervision relays.**

5.3.5.5.1 Trip circuit/coil supervision relays shall be provided for circuit breakers trip circuit/coil supervision and Lockout trip relay circuit/coil supervision

5.3.5.5.2 Trip circuit supervision relays shall have a time delayed drop off (100 millisecond minimum) and shall be provided with self-resetting indicators or approved equipment.

5.3.5.5.3 Monitoring of breaker trip coil in both open and close position shall be provided.
5.3.5.5.4 Relays will have green LED which will light when circuit is okay

5.3.5.5.5 Relays shall have a minimum of two SPDT heavy duty contacts with at least 3A continuous current rating at 125V for interface to existing control and automation system.

5.3.5.5.6 The relay shall be designed and have rugged construction for reliability / dependability over a wide temperature range, even under extreme environmental conditions.

5.3.5.5.7 The supervision current shall always be less than 1.5 mA to avoid unwanted operation of the trip coils.

5.3.5.5.8 Shall be panel mounted, flush mounted on the front of the panel with connections from the rear.

5.3.5.6 **DC Supply supervision relay**

5.3.5.6.1 The relay shall be capable of monitoring the DC supply to which it is connected and indicating failure. It shall have at least 4NC potential free contacts

5.3.5.6.2 The relay shall have a 'time delay on drop-off' of not less than 100 milliseconds and be provided with operation indicator/flag/LED clearly visible. Green LED shall be lit on the relay when supply is available and okay

5.3.5.6.3 The relay shall detect supply DC failure after DC voltage falls below 70–90% (dependent on application) rated or exceeds 120% rated for a time period exceeding 100ms

5.3.5.6.4 Green colour supervision lamps of clustered LED type shall be provided on the panel to indicate availability of healthy DC supply.

5.3.5.7 **AC Voltage monitoring relays**

5.3.5.7.1 They shall Monitor under and over voltage in each phase for a three-phase relay. There shall be a dial for setting the under-voltage level and another dial for setting the over voltage level.

5.3.5.7.2 They shall detect Phase failure from over or under voltage as described above or from frequency failure and output an alarm

5.3.5.7.3 They shall monitor Phase sequence and output an alarm in case of failure

5.3.5.7.4 They shall have an Adjustable hysteresis for output contact drop off or pick up

5.3.5.7.5 They shall have an Adjustable time delay for output contact drop off or pick up

5.3.5.7.6 Shall have at least four (4) SPDT contacts

5.3.5.7.7 Shall have at least three status indication LED’s. They shall have a green LED for healthy status, yellow LED status for unhealthy status and a blinking LED for time delay.
5.3.6 SWITCHBOARDS, PANELS AND CABINETS REQUIREMENTS

5.3.6.1 General requirements

5.3.6.1.1 Switchboards, panel and cabinets shall be of robust construction, formed of a steel frame and covered with smooth steel plate. The steel plate shall be folded sheet steel of not less than 2.0mm thick and properly stiffened to prevent distortion. Panels shall normally be covered at their rear with hinged doors. The frames of the boards and panels shall be designed to permit firm anchoring on the floor. The frames shall permit easy erection, and allowance shall be made for extension of the board by similar additional panels. All enclosures shall be ventilated so that the temperature inside the enclosure does not rise more than 5°C above ambient even with possible heaters connected.

5.3.6.1.2 All Equipment and materials for use in Switchboards, panel and cabinets shall not be flammable and shall be self-extinguishable and resistant to flame propagation.

5.3.6.1.3 Outdoor-cabinets and cabinets for moist environments shall be provided with thermostat-controlled heaters to inhibit collection of moisture. The heater must be arranged not to overheat any cables or equipment. Openings for drainage of condense shall be provided at the lowest point in the cabinets.

5.3.6.1.4 Panels and other enclosures shall be designed with an ingress protection suitable for the equipment mounted inside. However, as a minimum all outdoor panels and cubicles shall have IP rating of 55 or higher and for indoor panels and cubicles IP rating of 42 and higher.

5.3.6.1.5 All major or important compartments containing electrical equipment shall be provided with a single phase 16 A square pin socket and internal LED lighting facilities switched off by a door switch.

5.3.6.1.6 Unless otherwise specified or agreed upon, all instruments, apparatus and devices on the panel fronts shall be provided for flush mounting. Panels with flush mounted devices shall be provided with transparent cover. The cover shall be a hinged to allow resetting and adjustment. All terminals and all equipment shall be accessible without dismantling other components. Equipment shall not be mounted in swing-out doors. However, proper swing out frames may be used.
provided they can be opened will full load without twisting or distorting the panel. Windows shall be provided in front of rack mounted equipment.

5.3.6.1.7 All panels shall be provided with LED Lamp lighting fixture rated for 240V AC/110V DC/24VDC supply, controlled by panel door switch and fuse. The number of such LED lighting fixtures shall be at least two per panel.

5.3.6.1.8 All panels, boards and cabinets doors shall be provided with handles and key operated locks. All doors and removable covers shall be gasketed all round with neoprene gaskets, ventilating louvers with screen and filters.

5.3.6.1.9 The panel shall be provided with 240V, 50Hz. 15 A, 3 pin British type universal socket with switch. The socket with switch shall be mounted inside the panel at convenient location.

5.3.6.1.10 The new panels, cabinets and switchboards shall be constructed to fit in the existing space where the current panels, boards & cabinets are located with cable entry from bottom.

5.3.6.1.11 They shall have easy access to the wiring inside through the rear side of the panel.

5.3.6.1.12 The panels shall be factory wired with the reception terminal blocks for connection to the instrumentation transformers, circuit breakers tripping coils, alarm circuits and plant equipment.

5.3.6.1.13 The panels shall be mounted on approved form of anti-vibration mounting.

5.3.6.1.14 Relays, electronic cards and devices shall be identified with labels permanently attached to the device. All relays shall be firmly supported on their bases to avoid mal-operation due to vibrations when the unit is running.

5.3.6.1.15 Printed circuit boards SHALL NOT be mounted on the panels. All printed circuit boards shall be contained in enclosures with an ingress protection of at least IP20 with terminal blocks and ports on the enclosures for interface.

5.3.6.1.16 The bottom of the panels shall be sealed by means of removable gasketted steel plates. Gland plates for the bottom entry shall be at 100mm above the floor

5.3.6.1.17 A base plate for each panel shall be provided not exceeding 10cm in height.

5.3.6.1.18 All panels shall incorporate a common internal copper Earthing bar onto which all panel earth connections shall be made. Suitable stud or holes with the right screws shall be provided for connection to the main earth.

5.3.6.1.19 Appropriate eye bolts shall be provided to facilitate for easy lifting of the panels.

5.3.6.1.20 Panels and switchboards shall be labelled on the front and back at the top.

5.3.6.1.21 Marshalling cabinets, panels or boxes containing terminal blocks only shall be at least 400mm wide with a hinged door/s.
5.3.6.2 Wiring

5.3.6.2.1 All panel internal wiring shall be stranded flexible copper conductor with, suitable for operation at voltages below 1000 V and in compliance with the provisions of the applicable IEC Recommendations. Conductors shall not be smaller than 2.5 mm² for current & voltage transformer circuits and 1.0mm² for all other control circuits. The selection of conductor sizes for current transformer circuits shall be supported by calculations.

5.3.6.2.2 Wire runs shall be neatly arranged in trunks and properly clamped Wiring shall be securely supported, neatly installed by lacing and tying, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant, plastic wiring channels/troughs with strap on plastic covers shall be used for this purpose. Sufficient space in channel for modification of wiring shall be kept. For wiring within boards, the "bunch" pattern shall be adopted. Ample space shall be provided for running of cable within the enclosures.

5.3.6.2.3 The screens or screened pairs of multicore cables shall be earthed in accordance with a coherent Earthing philosophy to be worked out by the Contractor and approved by the Project Engineer. The screen and earth wires shall be terminated in terminals dedicated for this use. All free conductors in connecting cables shall be terminated in terminals that shall be temporarily connected to earth and special marked as specified in proceeding clauses.

5.3.6.2.4 Multi-stranded conductor ends shall be fitted with a suitable crimped thimble (bootlace ferrule type). The thimble shall be of correct type and length according to the core size and crimple tools shall be specially adapted to the thimble and cross section used. Each wire shall be separately terminated unless otherwise approved.

5.3.6.2.5 All connections shall be made at numbered terminal blocks; joints, splicing or paralleling of wires will not be accepted.

5.3.6.2.6 Accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

5.3.6.2.7 It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard/panel dead.

5.3.6.2.8 Wire termination shall be made with solder less crimping type of tinned copper lugs which firmly grip the conductor. Insulation sleeves shall be provided at all the wire terminations.
5.3.6.2.9 Engraved core identification plastic ferrules, factory marked to correspond with panel wiring diagram shall be fitted at both ends of each conductor. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. These markers (ferrule) shall be of an approved type attached to the conductor insulation.

5.3.6.2.10 The wire numbers shown in the wiring diagram shall be in accordance with BS152/BS156.

5.3.6.2.11 The ferrules shall be factory numbered, indelibly marked by engraving with black letter on a white background PVC casting. All wires directly connected to trip circuit breaker or devices shall be distinguished by white letter on a red background PVC casting.

5.3.6.2.12 The method of ferruling shall be subject to approval by the Employer; Wire marker (ferrule) shall contain both origin device/terminal block terminal Number and destination device/terminal block terminal. If single numeric digit ferrule is to be used Number 6 and 9 shall not be used.

5.3.6.2.13 The unused space on the front or rear of the panels shall be kept clear of wiring to facilitate addition of devices without rewiring associated portion of the panels.

5.3.6.2.14 The contractor shall be responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

5.3.6.3 Phase arrangement

5.3.6.3.1 The standard phase arrangement when facing the front of the panel shall be L1-L2-L3-N, and L-N from the left to right, from top to bottom, and front to back for A.C three-phase and single-phase circuits. For DC circuit it shall be N-P from left to right, P-N from top to bottom and front to back. All relays, instruments, other devices, buses and equipment involving three-phase circuit shall be arranged and connected in accordance with the standard phase arrangement wherever possible.

5.3.6.4 Terminal blocks

5.3.6.4.1 General requirements

(a) All panel wiring shall terminate at terminal blocks, the terminal blocks shall be of the moulded type and provided with barriers to separate power from control cables. It shall be possible to replace a single terminal block without dismantling a whole column. They shall be clearly marked, the designations being those entered in the respective wiring diagrams. ALL terminal blocks shall be capable of receiving 2.5mm² conductors.
(b) Only one conductor shall be connected to each side of a terminal block and the branch-offs shall be made by interconnecting the necessary number of neighbouring blocks by means of shorting plugs.

(c) Terminal blocks using screws acting directly on the wire (conductor) as well as spring type terminal blocks are NOT acceptable. To avoid squeezing of the wire the screw pressure shall be applied by a pressure plate having smooth edges. ‘OBA’ terminal blocks are not acceptable. Only terminal blocks that are operated using screw drivers are acceptable.

(d) Terminal blocks for different voltages SHALL NOT be mixed between one another. All conductors in a multi-core cable shall be terminated on the same terminal block column if they are of the same voltage. The blocks shall be grouped for each voltage and they shall be clearly marked for easy identification of the system voltage. Terminations on T.B. shall be grouped function wise on one region of T.B. (may not be full T.B)

(e) There shall be at least 20% spare terminal blocks on each block.

(f) All spare contacts/terminals of the panel mounted equipment and spare cores/conductors of cables terminated in a panel shall be wired up to terminal blocks with ferrule numbers starting with U.

(g) Moulding materials making up the terminal blocks shall be self-extinguishing or resistant to flame propagation, substantially non-hydroscopic and shall not carbonized when tested for tracking. The insulation between any terminal and framework between adjacent terminals shall with stand test of 2kV RMS for one minute. The moulding shall be mechanically robust to withstand handling while making terminations.

(h) Terminal blocks shall be located at least 300mm from the bottom of the panel and shall be easily accessible. All terminal blocks shall be vertically oriented in a panel; horizontally aligned terminal blocks shall NOT be accepted. Marshalling Panels containing terminal blocks only shall be at least 400mm wide.

(i) Each Individual Terminal Block shall be marked with a distinctive Number, which shall be the same Number used in the drawings, for identification purposes. The TB number shall be engraved in black numbers in white background.

(j) Each set of terminal Block shall be identified by a label to distinguish it from another set of terminal blocks with similar Numbers for the individual terminal blocks. The labels used will match those used in the drawings.
5.3.6.4.2 Terminal blocks for CT, VT and auxiliary power supply AC/DC, wiring:
(a) Shall be rated as follows:
   (i) Voltage: $\geq 800$ V AC,
   (ii) Continuous current rating @ $40^\circ$C ambient: $\geq 40$ A,
   (iii) Rated impulse withstand voltage: $\geq 8$ KV
   (iv) Cross sectional area: $\geq 6$ mm$^2$
(b) Shall be provided with test links and isolating facilities
(c) Shall have “banana” sockets on both sides of the terminals for testing;
(d) Terminals shall be so arranged that they fall into closed position when loose;
(e) CT terminal blocks shall be
   (i) equipped with a sliding splice for separation
   (ii) have cross connectors to short neighbouring terminals before sliding links open.
   (iii) shall be arranged in a manner to allow connection of additional circuit in series;
(f) Shall be suitable for connecting multi-stranded conductors of cross-sectional area of $1$ mm$^2$ – $4$ mm$^2$ with edge processing (bootlace)

5.3.6.4.3 Terminal blocks for control circuits
(a) Shall be used for all control/metering/protection circuits (all other circuits apart from those described in (clause 5.3.6.4 (b) rated up to 125V DC or 240V AC wiring:
(b) Shall be rated as follows:
   (i) Voltage: $\geq 600$ V AC,
   (ii) Continuous current rating @ $40^\circ$C ambient: $\geq 16$ A,
   (iii) Rated impulse withstand voltage: $\geq 6$ KV
   (iv) Cross sectional area: $\geq 6$ mm$^2$
(c) Shall have a Knife disconnect/isolator between the wire terminals
(d) shall have two slots on both sides of the knife disconnect for inserting shorting plugs or “banana” test plugs.
(e) Each terminal block shall have two terminals for wire connections on each side of the terminal block i.e four connections per terminal block
(f) Shall be suitable for connecting multi-stranded conductors of cross-sectional area of $1$ mm$^2$ – $4$ mm$^2$ with edge processing (bootlace)

5.3.6.4.4 Power terminal blocks
(a) Shall be used for single phase and three phase power feeder circuits rated below 150A

(b) Shall be rated as follows:
   (i) Voltage: ≥1000V AC,
   (ii) Continuous current rating @ 40°C ambient: 75–250 A,
   (iii) Rated impulse withstand voltage: ≥8KV

(c) Shall be flame resistant and suitable for operating voltages of 1kV.

(d) Shall consist of threaded studs and nuts M4-M12, partition plates and covers. Cable lugs (eye/horse shoe) shall be used to terminate the cables to the power terminal blocks

(e) Nuts shall be locknut, locking nut type that can resist vibrations

(f) The conductors shall be attached to the terminals using crimped cable lugs. Each connection shall be secured by tightening the hexagonal nut. The cable lugs shall be put between the washer on the clamp support.

(g) The terminals shall have an integrated hinge cover, with a high degree of finger safety. When closed, the cover shall lock onto the terminal and protect the contact from accidental contact.

(h) Neighbouring terminals shall have Shock protection provided by partition plates. The cover strips shall be locked into the guides of the partition plates and held with clips to prevent them slipping to the side.

(i) Shall be suitable for connecting conductors of cross-sectional area 2.5mm² – 50mm²

(j) Circuits rated over 150 A shall use busbar connections and not terminal blocks

5.3.6.5 Labelling

5.3.6.5.1 All Panels, switch boards, cubicles and all front mounted equipment as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved for identification. The labels shall be mounted directly above the respective equipment with English description and also where appropriate the IEC Number

5.3.6.5.2 The Device Name/Number shall correspond to the Name/Number used in the drawings. All panel devices shall also be provided tag numbers corresponding to the ones shown in the panel internal wiring drawing to facilitate each tracing of wiring. These labels shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.
Labels shall be made of Aluminium anodized plate or engraved plastic Castings. The entries on the plates shall be indelibly marked by engraving with black letter on a white background. The plates shall be made of weatherproof and corrosion-proof materials and shall not be deformed under the service conditions at the site.

All devices e.g. relays, timers, MCB’s, instruments etc. shall be given standard IEC abbreviation numbers with name of device, corresponding to the ones shown in the panel internal wiring drawings.

Major equipment shall be provided with a rating plate containing the necessary information specified in the relevant IEC standards.

**Auxiliary Supply**

Contractor shall reconnect the existing AC / DC supply for Switches, Panel illumination, space heater etc. and supplies for control and protections of existing panels. Where deemed necessary a fresh connection shall be made from the power distribution boards, the contractor shall be expected to supply cables and associated switchgear e.g. circuit breakers where necessary.

Devices and equipment shall be suitable or adopted for 110V (±20%) DC supply and 240V/415V (±10%) AC supply which is existing at the station.

**Earthing (Grounding)**

There shall be exposed and accessible Earthing bars in all panels connected to the existing station Earthing/grounding system. Cables shall be earthed and shielded in accordance with Earthing philosophy worked by contractor. All connections between equipment and the Earthing network shall be exposed (not embedded) and easily accessible for checking of the transition points.

Contractor shall take the necessary measures and furnish the required material for the safe Earthing of:

(a) All steel structures, metal parts and overhead ground wires.
(b) All metal parts, even if these do not constitute a conducting part of an electric system of the plants, such as machinery, operating desks, piping, sewers, rails, metal tanks, lighting, fixtures, cable racks, etc.
(c) All operational electric systems such as power and instrument transformers, lightning arresters, control equipment etc.
5.3.7 CABLES AND CONDUCTORS

5.3.7.1 General Requirements

5.3.7.1.1 ALL CABLES SHALL BE steel wire or Aluminium wire ARMoured.

5.3.7.1.2 The cables shall be marked with item designation in both ends as well as by entrances in enclosures. The cable marking shall be fire proof.

5.3.7.1.3 Cable markers shall be installed at the beginning and end of the cable.

5.3.7.1.4 Cables shall be neatly arranged, well supported and labelled at the glanding or termination point.

5.3.7.1.5 No joints shall be allowed.

5.3.7.1.6 Cables shall be wound on strong drums arranged to take a round spindle of a section adequate to support the loaded cable drum during installation and handling. The drums shall be lagged with closely fitting battens that shall be securely fixed to prevent damage to the cable. Wooden drums shall be constructed of seasoned timber to prevent shrinkage of drums during shipment and subsequent storage at site. Each drum shall be clearly marked including indication of direction of rolling.

5.3.7.1.7 The ends of the cables shall be suitably sealed to prevent ingress of moisture. The end of the cable left projecting from the drum shall be securely protected against damage by mishandling during transport and storage.

5.3.7.1.8 All control wiring shall be carried out with 1100V grade multi strand flexible copper conductor wires with HRPVC insulation and shall be flame retardant, vermin and rodent proof. Cables with twisted pairs for analogue signals (4-20mA, 0-10V etc.) shall be shielded to reduce EM interference.

5.3.7.1.9 All conductors shall be multi-stranded copper. The conductor shall be new, clean, uniform in size, shape and quality, smooth and free from scale, splits, sharp edges and other harmful defects. The conductor shall be in accordance with IEC 60228. The conductor shall be filled with swelling powder to stop axial ingress of moisture.

5.3.7.1.10 The maximum continuous current carrying capacity and maximum permissible continuous conductor temperature, and the factors for determining such rating and temperature shall be based on recommendations found in BS 7671 requirements for industrial installations and IEC 60287, subsequent amendments and all conditions prevailing on the Site.

5.3.7.1.11 All conductors cross section must be checked against max load current, allowable burden on measuring transformers, short circuit values, voltage drop,
protection requirements and selectivity. Conductors however shall have minimum cross sections as follows:

(a) Measuring cables from VT & CT output - 2.5 mm²
(b) Control and other measuring cables - 1.0 mm²
(c) Power cables according 120 % max load current with a minimum of 2.5 mm²
(d) Analogue signal cable-shielded twisted pairs-0.75mm²
(e) Networking cables- shielded twisted pairs -cat7

5.3.7.1.12 The standard phase colours for AC supply conductors including CT & VT output are: Red for L1 phase, Yellow for L2 phase, Blue for L3 phase, black for neutral and Green with yellow stripe for Earth/ground wires or as per relevant recent IEC standard.

5.3.7.1.13 For auxiliary DC Supply, Red for Positive and black for negative. Conductors for instrumentation and control signals shall be numbered clearly along the whole cable length for easy identification

5.3.7.2 **Cable Laying and Routing**

5.3.7.2.1 The final routing of HV and LV cables in indoor and outdoor installations shall be determined by the project engineer, from the directives given in Particular Specifications, and the principles shown in the layouts on the drawings. All cable routing must adapt to obstacles as tubes and ventilation channels. All penetrations of fire zone separations shall have the same fire classification as the separation itself.

5.3.7.2.2 Cables shall be laid on corrosion resistant (aluminium or hot dipped galvanised) cable trays and racks and by raising cables fixed to cable ladders. The trays shall be dimensioned and fixed so that it allows one man to climb on it in addition to the cable load. Each tray shall have at least 15 % spare capacity. The distance between each tray shall at least be 300 mm. For exposed outdoor installations cables shall be laid in covered cable trenches, plastic or steel ducts, depending on the available space.

5.3.7.2.3 Branch offs to individual equipment shall be fixed and supported all the way to the connection box. Cables and cable supports shall be properly fixed and secured against movement under short-circuit and strain caused by erection work. Particular attention shall be given to termination in confined areas where personnel may climb under erection and maintenance. Flexible tubes of “spiral type” shall not be used whereas tubes of “plica” type can.
5.3.7.2.4 Low power cables, i.e. cables for control, metering, etc. shall not be run in close parallel to high power cables or earth wires but shall be run at the greatest possible separating distance. The minimum distances are:

5.3.7.2.5 High and medium voltage versus control and measuring cables 800 mm

5.3.7.2.6 Low voltage power cables versus control and measuring cables 400 mm

5.3.7.2.7 Necessary EMC consideration shall be taken in accordance with EMC standards.

5.3.7.2.8 Additionally, cables for extra low power, i.e. mA and mV circuits and cables connected to low power solid state electronic circuits, shall be laid in separate sheet steel trays with covers.

5.3.7.2.9 Single-phase power cables shall be run in trefoil configuration, single-phase AC power cables shall be run in parallel. Special care shall be taken so that closed magnetic circuits do not form around single-phase cables.

5.3.7.2.10 Cables shall be laid in full runs and not spliced unless approved by Project Engineer. Termination of multi-stranded conductor ends shall be with a suitable crimped thimble as specified above. All other cable lugs or similar shall be of crimped type adapted to the cable type and cross-section used. The tools used should be special approved for the lugs and cable type used.

5.3.7.2.11 All cables shall be well marked with heat and oil resistant markers

5.3.7.2.12 The cable supplier’s instructions regarding handling and bending radius shall be followed.

5.3.8 NETWORKING EQUIPMENT

5.3.8.1 Twisted Pair Ethernet Patch Panels

5.3.8.1.1 Twisted pair patch panels shall be rack mount or panel mount 24 port CAT 7 (RJ45) shielded networking patch panels

5.3.8.1.2 All devices RJ45 ethernet ports in a panel other than management (console) RJ45 ports shall be wired to a patch panel.

5.3.8.1.3 All network patch cords shall be labelled with a suitable printed indelible ink cable marker.

5.3.8.1.4 All patch panel ports shall be well labelled, with computer generated (printed) indelible ink labels

5.3.8.1.5 Patch panels connector A shall be RJ45 (8p8c)

5.3.8.1.6 Patch panels connector B shall be either

(a) RJ45(8p8c) or
(b) TERA™
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3.8.1.7</td>
<td>Patch panels shall be shielded and suited for 600Mhz operation for category 7 10Gb ethernet cables termination</td>
</tr>
<tr>
<td>5.3.8.1.8</td>
<td>Rack mounted panels Shall be sized for mounting on 19” racks</td>
</tr>
<tr>
<td>5.3.8.1.9</td>
<td>Patch panel shall be designed for operation at continuous temperature of between 0 &amp; 40°C.</td>
</tr>
<tr>
<td>5.3.8.1.10</td>
<td>Patch panels must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided</td>
</tr>
</tbody>
</table>

### 5.3.8.2 Fibre optic Ethernet Patch Panels

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3.8.2.1</td>
<td>Fibre optic patch panels shall be twenty-four (24) port rack mount or panel mount suitable for terminating both single mode and multimode fibre optic cables</td>
</tr>
<tr>
<td>5.3.8.2.2</td>
<td>The panels shall be factory pre-populated and tested fibre patch panel with factory pre-loaded Twenty-four LC or SC or ST (as per particular specifications) adapters</td>
</tr>
<tr>
<td>5.3.8.2.3</td>
<td>Panels enclosure shall be made of Sturdy 16-gauge steel construction with a durable powder coat finish</td>
</tr>
<tr>
<td>5.3.8.2.4</td>
<td>Panel shall contain a moving tray for built-in cable management for holding and arranging the cables. This drawer mechanism shall enable easy access to the rear of the panel and eliminates the need for removing the panel from above.</td>
</tr>
<tr>
<td>5.3.8.2.5</td>
<td>Four cable entry cut outs shall be provided for cable entry including four cable entry glands.</td>
</tr>
<tr>
<td>5.3.8.2.6</td>
<td>Panel shall contain strain relief saddles to provide cable strain relief within the panel.</td>
</tr>
<tr>
<td>5.3.8.2.7</td>
<td>Various accessories, including splice cassettes, fusion protection sleeves, protection sleeve holders, etc., shall be provided for termination of at least four, four pair fibre optic cables.</td>
</tr>
<tr>
<td>5.3.8.2.8</td>
<td>Four fibre management clips shall be included to provide orderly excess cable storage while maintaining minimum bend radius.</td>
</tr>
<tr>
<td>5.3.8.2.9</td>
<td>Grounding points shall be provided on the rear of the panel, which, in conjunction with a F/O Cable Ground Kit, shall allow grounding of armoured fibre optic cables.</td>
</tr>
<tr>
<td>5.3.8.2.10</td>
<td>The panel shall include at least twenty-four port caps for protection of the front port modules</td>
</tr>
<tr>
<td>5.3.8.2.11</td>
<td>Rack mounted panels Shall be sized for mounting on 19” racks</td>
</tr>
</tbody>
</table>
5.3.8.2.12 Patch panel shall be designed for operation at continuous temperature of between 0 & 40°C.

5.3.8.2.13 Patch panels must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided

5.3.8.3 **Twisted Pair Ethernet Patch chords**

5.3.8.3.1 Shall be factory pre-made shielded category 7 cables with screened twisted pairs and gold plate shielded connectors.

5.3.8.3.2 Cable shall be Shielded Twisted Pair Cable (SSTP), Category 7 (600 MHz), 4 pairs, Solid, 23 AWG, with 4 separately foil-shielded pairs, overall braid shielded and an FR-PVC cable jacket

5.3.8.3.3 Cables shall have a durable, halogen free, flame retardant PVC jackets

5.3.8.3.4 Connector shall be shielded factory pre-made RJ45 8P8C male connector with gold plate shield and factory-pre-made dense FR-PVC jacket Or factory-pre-made Tera™ male connectors.

5.3.8.3.5 All RJ45 8P8C connectors must be gold plate shielded.

5.3.8.3.6 Patch cords shall be factory pre-made with a suitable length at least 2 meters.

5.3.8.3.7 Patch cords shall be designed for operation at continuous temperature of between 0 & 40°C.

5.3.8.3.8 Patch cords shall meet requirements of ANSI/TIA/EIA-568-B.1 standard

5.3.8.4 **Fibre optic patch chords**

5.3.8.4.1 They shall be Single mode duplex LC-LC connector Fibre optic patch cords

5.3.8.4.2 Shall have factory Pre-terminated connectors on both ends LC to LC (four LC connectors per patch chord)

5.3.8.4.3 Fibre Patch Cable shall be Single mode 9/125 OS1 fibre designed for Gigabit Ethernet Speeds

5.3.8.4.4 Shall conform to TIA/EIA 492AAAA and IEC60793-2-10 A1b standards and RoHS specifications.

5.3.8.4.5 The SM jacket shall be at least 3.00mm in diameter.

5.3.8.4.6 Fibre patch cords shall be designed to operate at -20°C to +70°C and have a minimum installation bending radius of 5.0 cm and a minimum long-term bending radius of 3 cm.

5.3.8.4.7 SM jacket shall be flame retardant
5.3.8.4.8 Patch cords shall be designed for operation at continuous temperature of between 0 & 40°C.

5.3.8.5 **Indoor Twisted pair ethernet cables**

5.3.8.5.1 Shall be Shielded Twisted Pair Cable (SSTP), Category 7 (600 MHz), 4 pairs, Solid, 23 AWG, with 4 separately foil-shielded pairs, overall braid shielded and an FR-PVC cable jacket

5.3.8.5.2 Every pair shall be separately shielded with polyester aluminium foil, which covers 100% of the twisted pair

5.3.8.5.3 Cable Jacket shall be halogen free and flame retardant.

5.3.8.5.4 Cable roll length shall be 300m or 1000 feet

5.3.8.5.5 Cable shall be designed for operation at continuous temperature of between 0 & 40°C.

5.3.8.6 **Outdoor Twisted pair Ethernet cables**

5.3.8.6.1 Shall be Shielded Twisted Pair Cable (SSTP), Category 7 (600 MHz), 4 pairs, Solid, Outdoor, 23 AWG, with 4 separately foil-shielded pairs, overall braid shielded and jacketed with two FR-PVC compounds.

5.3.8.6.2 Cable shall meet IEC 61156 requirements Fire protection - CMX and IEC 60332-1, UL 1581 VW-1 fire safety standards.

5.3.8.6.3 Every pair shall be separately shielded with polyester aluminium foil, which covers 100% of the twisted pair

5.3.8.6.4 Materials:
(a) Conductive material: bare copper
(b) Conductor insulation: PO, film-porous-film structure
(c) The outer cable jacket: FR-PVC
(d) The inner cable jacket: FR-PVC
(e) General shield: tinned copper braid - 60% minimum
(f) Drain wire: tinned copper

5.3.8.6.5 Cable roll length shall be 300m or 1000 feet

5.3.8.6.6 Cable shall be designed for operation at continuous temperature of between 0 & 40°C.
5.3.9 SOFTWARE

5.3.9.1 Submission

5.3.9.1.1 One copy of each different type of Software in a CD Rom, for Protection Relays, communication gateways, SCADA/HMI systems and other measuring and Control Devices whose Configuration and Settings is Software based and the connection Cable (Two for each type of device) shall be provided to employer when equipment is shipped to site

5.3.9.1.2 Logic diagrams/programs, PLC application programs, HMI/SCADA application programs, document management application and all other programs developed by the contractor or his supplier or subcontractor for operation of any device supplied under this project shall be provided to employer in editable format when equipment is shipped to site

5.3.9.1.3 Software used to develop Logic diagrams/programs, PLC application programs, HMI/SCADA application programs, document management application and all other programs required for operation of any device supplied under this project shall be provided for installation into at least two portable computers with all necessary licences

5.3.9.1.4 Intellectual property rights for IED/ controller Logic diagrams/programs, PLC application programs, HMI/SCADA application programs, document management application and all other programs developed by the contractor or his supplier or subcontractor specifically for operation of any device supplied under this project/contract SHALL BE CEDED to the employer after commissioning

5.3.9.1.5 All the software required for configuring or programming IED’s, PLC’s industrial PC’s or any other programmable device whether explicitly mentioned in the specifications or not shall be supplied for installation to two portable PC’s. The software shall also be capable of downloading and analysing data from the IED/measuring device.

5.3.9.1.6 It shall be possible to load the configuration/programming software into at Least two different Laptop Computers without requirement for additional licenses, to facilitate Operations. Where additional licenses are required, the cost shall be considered to have been included in the bid.

5.3.9.1.7 All software/programs running on any of the supplied devices which may be required for installation/reinstallation into the device at any point in the lifetime of the device e.g. after changing some parts or repairing shall be supplied
5.3.9.1.8 One set of hard cover manuals for each type of software Supplied providing detailed

5.3.9.2 **Software Configuration Management Plan**

5.3.9.2.1 A Software Configuration Management (CM) Plan shall be produced defining the manner in which the changes to software are controlled and logged during the lifecycle of the project.

5.3.9.2.2 The Contractor shall identify the CM procedures to be applied to software development.

5.3.9.2.3 Specifically, the Contractor shall ensure that procedures exist to identify, document, control and maintain all software design changes. The procedures shall include a method for:

(a) Program and/or module version identification, registration and updating

(b) Obtaining approval to implement a modification

(c) Producing build documents at baseline

(d) Ensuring that modifications are properly integrated

(e) Keeping secure masters at separate locations

(f) The provision of validated copies

(g) The proper marking, storage and handling of software media

(h) The control of the identification inspection status

(i) The control of support software

(j) Ensuring that non-conforming software is identified and segregated.
5.4 PARTICULAR TECHNICAL SPECIFICATIONS

5.4.1 SCADA LCC CONTROL PANELS EQUIPMENT

5.4.1.1 General Requirements

5.4.1.1.1 Panels Layout

(a) Six (6) LCC control panels shall be supplied with all the equipment as detailed in the scope of supply installed and configured. A panel shall be delivered to each station.

(b) Six (6) Process LAN panels shall be supplied with all the equipment as detailed in the scope of supply installed and configured. A panel shall be delivered to each station.

(c) Each LCC control panel shall contain a minimum of the following major equipment

   (i) Two (2) Rack mount industrial PC meeting requirements of clause 5.4.1.3

   (ii) One (1) Thin client PC meeting requirements of clause 5.4.3.1

   (iii) Four (4) Rack mount industrial Ethernet Switches meeting requirements of clause 5.4.1.4

   (iv) One (1) Rack mount PTP grandmaster clock and time server with GNSS receiver meeting requirements of clause 5.4.1.5

   (v) One (1) DCF77 Time code converter meeting requirements of clause 5.4.1.6

   (vi) Four (4) Industrial cyber security appliance meeting requirements of clause 5.4.5.

   (vii) One (1) industrial grade LCD touch monitor meeting requirements of clause 5.4.1.7

   (viii) One (1) Four port KVM switch meeting requirements of clause 5.4.1.8

(d) RCC Each process LAN panel shall contain a minimum of the following major equipment

   (i) Two (2) Rack mount industrial Ethernet Switches meeting requirements of clause 5.4.1.4

(e) All panel, electrical and networking accessories shall be provided for and installed as detailed in clause 5.4.1.2
(f) The contractor shall supply, assemble, configure and test all the panels equipment prior to factory acceptance testing witnessed by the procuring entity.

(g) LCC panel equipment shall contain the following minimum number of ports and maximum device mounting rack units:

<table>
<thead>
<tr>
<th>No.</th>
<th>Equipment/part Description</th>
<th>Qty</th>
<th>Maximum Rack units for each device</th>
<th>Minimum RJ45 ethernet ports on each device</th>
<th>Power supply units on each device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rack mount Industrial Ethernet switches</td>
<td>4</td>
<td>1</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Rack mount industrial computers</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Rack mount PTP Grandmaster clock/ Time server with integrated GPS receiver</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Thin client PC</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Industrial security appliance</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>19” industrial grade Touch monitor</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Rack mount console keyboard</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>4 port KVM switch</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>DCF77 Time code output converter</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>24 port rack mount RJ45, Cat7, SSTP ethernet patch panels</td>
<td>5</td>
<td>1</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>24 port rack mount Fibre optic patch panels (LC)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

5.4.1.1.2 Panel design

(a) Electrical wiring and networking of the panel shall be carried out as per approved drawings.
(b) Bidder shall design panel electrical schematic drawing based on the tender specifications, OEM requirements and any other requirements necessary for optimal operation of the cabinet and cabinet mounted equipment. The drawing shall be submitted for review and approval as detailed in clause 5.1.7.

(c) During design, contractor shall ensure all requirements of the OEM for optimal operation of the equipment have been met. All components and accessories proscribed by the OEM for optimal operation of the mounted equipment shall be provided for and installed by the contractor irrespective of whether such devices have been included in the tender specifications.

(d) Panel structural drawing and panel layout drawings showing device placement shall carried out by the contractor and submitted for approval as detailed in clause 5.1.7.

(e) Sizing of electrical protection devices such as MCB’s shall be carried out as per requirements in clause 5.3.3 and OEM requirements.

(f) Electrical equipment shall utilise nominal auxiliary supply of 110V DC - 125VDC or 220V AC-240 VAC as detailed in clause 5.3.3. Power supply units meeting requirements in clause 5.3.3.5 shall be installed in the cabinet for supply of power to devices requiring any other auxiliary power supply other than the one specified above, irrespective of whether.

(g) Electrical wiring cables and conductors shall meet OEM requirements and requirements in clause 5.3.6 and 5.3.7.

(h) Cubicle shall be installed in an environment with average temperature of 40°C. The equipment in the cabinet shall be designed for continuous operation at this temperature without derating and external forced cooling.

(i) Two redundant (1+1) fans rated for a minimum of 750m³/hour air flow rate shall be installed at roof of the cabinets to improve panel cooling and extend the life of the installed equipment. However, the panel shall be designed for operation without the fans.

(j) Panel materials shall meet the requirements of clause 5.3.2, panel design shall meet the requirements of clause 5.3.6 and all the requirements of clause 5.4.2.6.

(k) All external cables shall terminate to a terminal block or a patch panel. All cabinet devices ports and terminals shall be wired/connected to patch panels or terminal blocks for connection to external cables during installation by the procuring entity.
(l) All ethernet ports of equipment mounted in the cabinets shall be connected to the patch panels. Ethernet connections between devices on the cabinets shall be via patch panel ports but not directly between device to device except for fibre optic patch cords which shall be connected directly between devices.

(m) Ethernet twisted pair patch panels shall be rack mounted on the front side of the cabinets and panel mounted or DIN rail mounted at the rear side of the panel. The cabinet wiring shall be very neat and shall allow easy access of the internal equipment.

(n) All networking cables shall be guided around the panel using cable trunks

5.4.1.1.3 System Architecture

(a) The equipment shall be connected as shown on the specification drawing.

(b) There shall be two LAN each formed by two industrial ethernet switches. Each LAN shall be fully redundant with two switches and most devices connected to both industrial ethernet switches.

(c) The two industrial PC shall host the SCADA data acquisition server and LCC operator client installed into virtual machines. Each Industrial PC shall contain two virtual machines one for windows 2016 server and the other Windows 10 enterprise IOT LTSB.

(d) Thin client PC shall be a remote terminal for accessing the Windows 2016 server virtual machines.

(e) The industrial PC’s and workstation in each cabinet shall be connected to KVM switch for local administration. The console keyboard and the industrial touch monitor shall be connected to the KVM switch.

(f) The industrial PC’s shall be redundant, they shall be similar in all manner. The applications to be installed in their virtual machines shall have a failover between them.

(g) Each of the following devices shall have dual redundant supplies

   - Rack mount Industrial Ethernet switches
   - Rack mount industrial computers
   - Rack mount PTP Grandmaster clock/ Time server with integrated GPS receiver
   - Industrial security appliance

   The supplies shall be wired as follows

   - One of each device’s power supply units shall be connected to 240V AC source via MCB’s
- One of each device’s power supply units shall be connected to 110V DC source via MCB’s
- All the connections shall be hardwired to the terminal blocks
- For each device an auxiliary contact shall be wired to the terminal blocks for external device failure alarm annunciation

(h) Two dual redundant LAN shall be installed in the panel as illustrated in the specification drawing. The two redundant LAN shall be completely isolated via the security appliances.
(i) Industrial PC’s shall be time synchronised to an accuracy exceeding 10 micro seconds. If the PC does not support PTP, IRIG-B serial port shall be provided and connected to the PTP grandmaster IRIG-B serial port output

5.4.1.2 LCC panels

5.4.1.2.1 General Requirements

(a) Shall abide to all specifications in clauses 5.3.6 & 5.3.7 of general technical specifications
(b) All LCC panels shall have a minimum of two doors. Rear door and a front cover door for covering and protecting panel mounted devices. All doors shall have locks.
(c) Front door shall have a poly carbonate window to allow viewing of device indications whilst the door is locked
(d) Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.
(e) Rack mount keyboard drawer shall be provided and mounted into the panel. It shall house a 108-Key US ANSI English Layout Keyboard with 2m USB cord and USB optical mouse which shall be provided for and installed by the contractor.
(f) Panel shall contain Mounting Rails meeting requirements of clause 5.4.2.6.7 to support installation of industry standard 19” equipment
(g) Panel ingress protection shall be IP54 as per IEC 60529
(h) LCC panels shall be factory assembled and tested.
(i) FAT witnessed by procuring entity for Industrial PC’s, industrial ethernet switches and the industrial time server shall be carried out at the factory where these devices are manufactured.

5.4.1.2.2 Networking accessories

(a) A minimum of the following networking equipment and accessories shall be supplied and installed into each LCC panel

(i) Five (5) twisted pair Cat 7, 24 port shielded patch panels meeting requirements of clause 5.3.8.1

(ii) One (1) twenty-four port Fibre optic panel meeting requirements of clause 5.3.8.2 with twenty-four LC port modules

(iii) One hundred and twenty (120) cat 7 twisted pair ethernet patch chords meeting requirements of clause 5.3.8.3 for device to patch panel connections. The patch chords shall either be RJ45 to RJ45 or RJ45 to TERA™

(iv) Sixty (60) cat 7 RJ45 to RJ45 twisted pair ethernet patch chords meeting requirements of clause 5.3.8.3 for patch panel to patch panel connections.

(v) Four (4) Single mode duplex LC-LC connector Fibre optic patch cords meeting requirements of clause 5.3.8.4 for cascading the two ethernet switches in each cabinet

(vi) Six (6) rack mount cable entry panels for guiding the networking cables.

(b) A minimum of the following networking equipment and accessories shall be supplied and installed into each Process LAN panel

(i) Three (3) twisted pair Cat 7, 24 port shielded patch panels meeting requirements of clause 5.3.8.1

(ii) One (1) twenty-four port Fibre optic panel meeting requirements of clause 5.3.8.2 with twenty-four LC port modules

(iii) Forty-eight (48) cat 7 twisted pair ethernet patch chords meeting requirements of clause 5.3.8.3 for device to patch panel connections. The patch chords shall either be RJ45 to RJ45 or RJ45 to TERA™

(iv) Two (2) Single mode duplex LC-LC connector Fibre optic patch cords meeting requirements of clause 5.3.8.4 for cascading the two ethernet switches in each cabinet

(v) Three (3) rack mount cable entry panels for guiding the networking cables.
(c) All devices and components required to network (local area network) all the major components in each cubicle as listed in clause 5.2.4.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.4.1.2.3 **Electrical wiring**

(a) All electrical accessories detailed in clause 5.2.4.12 and 5.2.5.5 shall be supplied and installed into the panels

(b) Panel power supplies shall be designed and installed as per requirements of clause 5.3.3

(c) Miniature circuit breakers, shall meet requirements of clause 5.3.3.3

(d) Panel electrical wiring shall be carried out as detailed in clause 5.3.6

(e) Terminal blocks shall meet requirements of clause 5.3.6.4

(f) Socket Strips
   (i) They shall meet requirements of clause 5.3.3.6
   (ii) A socket strip composed of at least four British type (IEC Type G) sockets shall be rack mounted on the front side of each panel.
   (iii) The socket strip shall have an illuminated switch facing the front side of panel
   (iv) Double socket Euro type (CEE 7/3) DIN mount socket strip shall be mounted on the rear of each cabinet.
   (v) Double socket British type (IEC type G) DIN rail mount socket strip shall be mounted on the rear of each cabinet
   (vi) Socket Strips power supply input shall be hardwired directly to wiring terminal blocks.

(g) Panel cooling Ventilation fans
   (i) Dual redundant ventilation fans to be installed on the panel roof for exhausting excess heat from the cabinet
   (ii) Shall be a roof exhaust unit for mounting on the top of the enclosure providing forced ventilation.
   (iii) Shall be made of Painted mild steel, and injection-moulded thermoplastic (ABS-FR) self-extinguishing,
   (iv) Temperature resistance: -15°C to +55°C.
   (v) Air flow of at least 750 m³/h
   (vi) Power supply rating 240V AC, 50Hz
   (vii) To be hardwired to the MCB
5.4.1.3 Industrial PC

5.4.1.3.1 General Requirements

(a) Mounting: Shall be rack mounted. Enclosure shall be 2U/3U/4U thick and 19 inch wide, for rack mounting.

(b) Power Supply. Shall be powered by (two) dual modular, hot-swappable redundant power supplies with an input range of 100–300 VDC. and 110–240V AC

(c) Temperature. Shall be capable of continuous operation over a temperature range of −40°C to +60°C at 100 percent processor burden. shall be type tested to IEC 60068-2-1:2007 (Test Ad 16 hr at −40°C), IEC 60068-2-2:2007 (Test Bd 16 hr at+60°C), and IEC 60068-2-30:2005 (Test Db 12 + 12-hour cycle at 25° to 55°C, 6 cycles).

(d) Environmental Testing. shall be tested to the same standards as protective relays including IEC 60255-21-1, IEC 60255-21-2, IEC 60255-21-3, IEC 60255-26:2013, EN 61000-4-2, EN 61000-4-4, and IEEE C37.90.1.

(e) Processor. The device shall use an Intel Xeon quad-core CPU operating at a clock speed of at least 2.7 GHz.

(f) Memory (RAM) The device shall support at least 32 GB of DDR4 RAM with error correction code (ECC) operating at a clock speed of at least 2.133 GHz.

(g) Cooling The device shall contain NO fans and shall be able to operate without derating at max CPU load at an ambient temperature of 40°C by utilising advanced solid-state cooling methods.

(h) Reliability for Utility substation use. Shall be designed and built to operate reliably in harsh environments, conforming to IEEE C37.90 and IEC 60255 Protective Relay Standards, IEC61850-3 and IEEE 1613 Standard Environmental and Testing Requirements for Communication Networking Devices in Electric Power Substations. Shall meet or exceed specifications for vibration, electrostatic discharge, fast transient, radiated emissions, dielectric strength, and pulse magnetic field disturbances.

(i) Communications Ports. shall have two front-panel USB ports, four rear-panel USB ports, two rear-panel serial ports, four (2) rear- panel 100/1000 base-TX Ethernet ports and two (2) rear1000base-X or 100base-X fibre optic Ethernet ports. All communications ports shall be ESD and RFI protected.
(j) **Hot-Swappable Industrial Solid-State Drives:** shall have high quality, industrial-temperature rated, single-level cell (SLC) NAND Flash solid-state drives. All drives shall support hot-swapping. The SATA SSD drives shall be easily accessible from the front panel.

(k) **RAID (Redundant Array of Independent Disks).** RAID levels 0, 1 & 5 shall be supported to allow for speed, availability, and disaster recovery, depending upon application.

(l) **CIS OS Security Benchmarks:** Operating systems shall provide a mechanism to quickly enable the Centre for Internet Security benchmark configurations to improve the device security posture.

(m) **Configuration.** Configuration of messages and data processing functions shall be through a simple GUI interface. Configuration interface shall be through local keyboard, mouse, and monitor port or via Windows Remote Desktop or Intel Active Management Technology (AMT).

(n) **Alarm Output.** There shall be an alarm contact output to signal internal errors and malfunctions. The alarm contact shall be supervised by an internal watchdog system that independently monitors the operating system.


(p) **Non-volatile Storage.** There shall be Flash memory used as non-volatile storage of settings, configuration, and incoming and calculated data within the device. Data stored in the non-volatile memory shall be available for retrieval after sustained power outage, including failure of the internal battery.

(q) **Moving Parts and Vent Holes.** The device shall not include any rotating disk drives, fans, moving parts, or vent holes.

(r) **Reliability.** The vendor shall supply the actual measured Mean Time Between Failures (MTBF) for the device upon request.

(s) **Power consumption:** Power consumption at maximum loading shall not exceed 150W

(t) **Service.** The device shall include no-charge technical support for the life of the product.
(u) **Manufacturer.** The device shall be manufactured in the United States, Canada or western Europe by reputable industrial computer manufacturers such as SEL, ABB or Siemens

(v) **Conformal Coating.** The device shall have conformal coating to protect the circuit boards from harsh environments.

(w) **Warranty.** The device shall include a ten-year, no-questions-asked warranty for all material and workmanship defects. In addition, the warranty shall cover accidental customer-induced damage

### 5.4.1.3.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Intel® Xeon®</td>
</tr>
<tr>
<td>2</td>
<td>No of processors &amp; sockets</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>3</td>
<td>No of cores on each processor</td>
<td>≥Four (4)</td>
</tr>
<tr>
<td>4</td>
<td>No of threads on each processor</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>5</td>
<td>Processor Base Frequency</td>
<td>≥ 2.8 GHz</td>
</tr>
<tr>
<td>6</td>
<td>L3 Cache</td>
<td>≥ 8MB</td>
</tr>
<tr>
<td>7</td>
<td>Processor TDP</td>
<td>≤50W</td>
</tr>
<tr>
<td>8</td>
<td>Installed RAM type</td>
<td>DDR4, ECC, 2133Mhz</td>
</tr>
<tr>
<td>9</td>
<td>Total installed RAM</td>
<td>≥ 32GB</td>
</tr>
<tr>
<td>10</td>
<td>Type of installed drives</td>
<td>Hot swap, Industrial Grade SLC with 10-year warranty</td>
</tr>
<tr>
<td>11</td>
<td>Size of each installed SSD drives:</td>
<td>≥ 256GB</td>
</tr>
<tr>
<td>12</td>
<td>Number of installed SSD drives:</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>13</td>
<td>Total SSD storage size</td>
<td>≥ 512GB</td>
</tr>
<tr>
<td>14</td>
<td>Drive bay</td>
<td>Hot swap configuration with front side access</td>
</tr>
<tr>
<td>15</td>
<td>Network controllers</td>
<td>One (1) dual port 1GB Base-T Ethernet controller and One (1) four port 1Gb Base-T &amp;100MB base-Fx Ethernet controller</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>16</td>
<td>Total number 1GB Base-T Ethernet ports (RJ45)</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>17</td>
<td>Total number 100MB Base-FX SFP Ethernet ports (RJ45)</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>18</td>
<td>100 Base-FX SFP modules</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>19</td>
<td>Time-Code Input</td>
<td>IRIG-B or PTP Accuracy &lt;10 microseconds</td>
</tr>
<tr>
<td>20</td>
<td>Time-Code Input port</td>
<td>Serial DB9 or BNC or onboard PTP ethernet port</td>
</tr>
<tr>
<td>21</td>
<td>Alarm Output Contact</td>
<td>≥ One (1) Form C (SPDT) relay contact</td>
</tr>
<tr>
<td>22</td>
<td>Alarm Output Contact rating</td>
<td>≥ 250 Vac/Vdc &amp; ≥ 5A continuous</td>
</tr>
<tr>
<td>23</td>
<td>Alarm Output Contact wiring</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>24</td>
<td>PCIe Expansion slots- PCIe X4/X8/X1</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>25</td>
<td>USB ports</td>
<td>≥ Four (4) rear ports &amp; ≥ Two (2) front ports</td>
</tr>
<tr>
<td>26</td>
<td>Video ports:</td>
<td>≥ Two (2) DVI/DP ports</td>
</tr>
<tr>
<td>27</td>
<td>Front side LED’s</td>
<td>(i) Ethernet port status LED (ii) Two power supply status LED’s (iii) Device status LED (iv) Alarm status LED (v) Drive status LED (vi) At least two configurable LED’s (vii) Lamp test push button</td>
</tr>
<tr>
<td>28</td>
<td>Power supply type</td>
<td>Hot swappable, dual redundant power supply (1+1)</td>
</tr>
<tr>
<td>29</td>
<td>Number of hot plug Power supply units</td>
<td>Two (2)</td>
</tr>
<tr>
<td>30</td>
<td>Power rating of each power supply unit</td>
<td>≥ 150W</td>
</tr>
<tr>
<td>31</td>
<td>Power input rating</td>
<td>110–240V AC, 50Hz &amp; 100–250V DC</td>
</tr>
<tr>
<td>32</td>
<td>Power supply connections</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>33</td>
<td>Enclosure type</td>
<td>Steel or metallic equivalent</td>
</tr>
</tbody>
</table>
5.4.1.3.3 **Software and configuration**

(a) The industrial PC’s shall be a virtual machine host, to host the employers’ SCADA data acquisition servers, SCADA LCC client applications and other applications. The fundamental aim of the virtualization shall be to allow back up and transfer of all industrial PC software and data to another hardware host machine in case of hardware failure with minimal or no changes to the applications.

(b) Each server shall contain latest Enterprise VMware vSphere (ESXi) native (bare metal) Hypervisor supported by hardware installed. The VMware hypervisor shall support all Microsoft windows operating systems from windows server 2016 to windows 1995.

(c) Each host server shall contain the following two Virtual Machines installed and tested by the contractor:

(i) Windows server 2016 or 2012 R2 standard edition with the following features
   - Perpetual OEM/FPP/volume licences supporting all the cores in the industrial PC.
   - At least Five (5) user CALS
• This virtual machine shall run the SCADA data acquisition server/s to be installed by the procuring entity. The VM will be accessed by remote login from the thin client PC

(ii) Windows 2016 enterprise IOT LTSB

• Perpetual licences supporting all the cores in the industrial PC.
• This virtual machine shall run the SCADA LCC client applications to be installed by the procuring entity. The VM will be accessed by remote login from the thin client PC

(d) Virtual machines shall be hardware independent; i.e. in case of Hypervisor machine hardware change, the virtual machines shall have to work with the same base features, with no specialist support for the substitution.

(e) Virtualisation and installation of VM’s in all the industrial PC’s, setting up of the virtualisation management client and the associated virtualisation set up shall be carried out by the bidder.

(f) Engineering Laptops shall host virtualisation software management client (vSphere client) required to manage the virtual machines installed on the industrial PC’s. The client software shall allow functions such as manual copying of Vm’s and creation of new Vm’s in the industrial PC hypervisor.

(g) Industrial PC shall be configured and optimised for industrial control applications by the contractor (industrial control applications shall be provided by the procuring entity). All features necessary for this shall be supplied, configured and tested by the contractor

5.4.1.3.4 **Product Standards**

The industrial PC shall be designed and tested as per the following standards

(a) Communications Equipment in Utility Substations:
   (i) IEC 61850-3:2013
   (ii) IEEE 1613-2009
   Severity Level: Class 1

(b) Industrial Environment:
   (i) IEC 61000-6-2:2005
   (ii) IEC 61000-6-4:2006

(c) Measuring Relays and Protection Equipment:
   (i) IEC 60255-26:2013
   (ii) IEC 60255-27:2013
5.4.1.3.5 **Type Tests**

The industrial PC shall have been type tested and passed the following type tests. Type test report/certificate to be attached with the bid offer.

(a) Electromagnetic Compatibility Emissions
   (i) Conducted and Radiated Emissions:
       • CISPR 11:2009 + A1:2010
       • CISPR 22:2008
       • CISPR 32:2015
       • IEC 61000-6-4:2006
       • IEC 61850-3:2013
       • FCC 15-107:2014
       • FCC 15-109:2014
       Severity Level: Class A
   (ii) Harmonic Current: IEC 61000-3-2:2014
       Severity Level: Class A
   (iii) Voltage Flicker: IEC 61000-3-3:2013

(b) Electromagnetic Compatibility Immunity
   (i) Conducted RF: IEC 61000-4-6:2013
       Severity Level: 10 Vrms
   (ii) Electrostatic Discharge:
       • IEC 61000-4-2:2008
       • IEEE C37.90.3-2001
       Severity Level:
       2, 4, 6, 8 kV contact discharge;
       2, 4, 8, 15 kV air discharge
   (iii) Fast Transient/Burst:
       • IEC 61000-4-4:2012
       Severity Level: Class A
       4 kV, 5 kHz on power supply and outputs;
       2 kV, 5 kHz on communications lines
   (iv) Magnetic Field:
       • IEC 61000-4-8:2009
       Severity Level:
       1000 A/m for 3 s
100 A/m for 1 m

(v) Power Supply:
- IEC 61000-4-11:2004
- IEC 61000-4-29:2000

(vi) Radiated Radio Frequency:

Severity Level: 10 V/m
- IEEE C37.90.2-2004

Severity Level: 20 V/m

(vii) Surge Withstand Capability:

Severity Level:
Power supply and outputs
2.5 kV peak common mode
1.0 kV peak differential mode

Communications ports
1.0 kV peak common mode
- IEEE C37.90.1-2012

Severity Level:
2.5 kV oscillatory
4 kV fast transient

(viii) Surge Immunity:
- IEC 61000-4-5:2005

1 kV line-to-line
2 kV line-to-earth
2 kV communications ports

(c) Environmental

(i) Change of Temperature:
- IEC 60068-2-14:2009

Severity Level:
5 cycles, 1°C per minute ramp
–40°C to +60°C

(ii) Cold, Operational:
- IEC 60068-2-1:2007

Severity Level: 16 hours at –40°C
(iii) Cold, Storage:
  - IEC 60068-2-1:2007
  Severity Level: 16 hours at –40°C
(iv) Damp Heat, Cyclic:
  - IEC 60068-2-30:2005
  Severity Level:
  12 + 12-hour cycle
  25°C to 55°C, 6 cycles, >93% r.h.
(v) Damp Heat, Steady:
  - IEC 60068-2-78:2012
  Severity Level:
  40°C, 240 hours, >93% r.h.
(vi) Dry Heat, Operational: IEC 60255-1:2009
  - IEC 61850-3:2013
  - IEC 60068-2-2:2007
  Severity Level:
  16 hours at 60°C
(vii) Dry Heat, Storage:
  - IEC 60255-1:2009
  - IEC 61850-3:2013
  - IEC 60068-2-2:2007
  Severity Level: 16 hours at 85°C
(viii) Free Fall:
  - IEEE 1613-2009
  Severity Level: 100 mm
(ix) Vibration:
  - IEC 60255-21-1:1988
  Severity Level:
  Endurance Class 2
  Response Class 2
  - IEC 60255-21-2:1988
  Severity Level:
  Shock Withstand, Bump Class 1
  Shock Response Class 2
  - IEC 60255-21-3:1993
  Severity Level:
Quake Response Class 2

(d) Safety
   (i) Enclosure Protection:
       • IEC 60529:2001 + CRGD:2003
   Severity Level: IP30
   (ii) Dielectric Strength: IEC 60255-27:2013
       • IEEE C37.90-2005
   Severity Level:
   3600 Vdc on power supply
   2500 Vac on contact output
   1500 Vac Ethernet ports
   Type tested for one minute
   (iii) Impulse: IEC 60255-27:2013
       IEEE C37.90-2005
   Severity Level:
   5 kV common mode, power supply,
   contact outputs
   1.5 kV Ethernet ports

5.4.1.4 Industrial Ethernet switches

5.4.1.4.1 General Requirements

(a) Virtual Local Area Networks (VLANs). The device shall support as many as 4,094 IEEE 802.1Q-2005 VLANs.

(b) Rapid Spanning Tree Protocol (RSTP). The device shall support IEEE 802.1D-2004 RSTP.

(c) Bridge Protocol Data Unit (BPDU) Guard. The device shall be capable of automatically disabling a port receiving unexpected BPDUs.

(d) MAC-Based Port Security. The device shall support MAC-based port security.

(e) Port Rate Limiting. The device shall support setting maximum ingress and egress rates on device ports.

(f) Multicast MAC Filtering. The device shall support filtering multicast MAC addresses.

(g) Layer 2 Traffic Prioritization. The device shall support IEEE 802.1Q-2005 VLAN and Priority Tagging CoS traffic prioritization.
(h) **Layer 3 Traffic Prioritization.** The device shall support DiffServ DSCP traffic prioritization.

(i) **Port Mirroring.** The device shall support mirroring ingress and egress frames to a target port.

(j) Simple Network Management Protocol (SNMP) v1/v2c/v3. The device shall support SNMP v1, v2c, and v3.

(k) **Link Layer Discovery Protocol (LLDP).** The device shall support IEEE 802.1AB-2009.

(l) **Graphical User Interface (GUI)-Based Secure Management.** The device shall provide a secure GUI-based management interface.

(m) **Automated Diagnostics and Reporting.** The device shall monitor health and functions and report state changes.

(n) **Settings Import/Export.** The device shall support importing and exporting device settings.

(o) **Secure Firmware Upgrades.** The device shall support authentication of firmware through digital signatures.

(p) **NTP Time Synchronization and Distribution.** The device shall be capable of performing as an NTP client.

(q) **Nonintrusive Monitoring and Setting.** The device shall provide an Ethernet interface to the HTTPS management port. The management port will be used for configuration settings and monitoring and will be protected with encryption and authentication algorithms.

(r) **Lightweight Directory Access Protocol (LDAP).** The device shall support centralized authentication through LDAP.

(s) **Remote Authentication Dial-In User Service (RADIUS).** The device shall support multifactor centralized authentication through RADIUS.

(t) **Configurable PCP to Priority Queue.** The device shall support configuring mappings of PCP to priority queue.

(u) **Configurable DSCP to Priority Queue.** The device shall support configuring mappings of DSCP to priority queue.

(v) **User-Based Accounts.** The device shall authenticate and authorize users using user-based accounts.

(w) **Logging.** The device shall log locally and forward event messages across an Ethernet network.

(x) **Configurable Alarm Contact.** The device shall support configuring the alarm contact behaviour for each event category.
(y) **Configurable Timer Contact:** The device shall support a configurable timing contact for precise timing functions.

(z) **Far End Fault Indication (FEFI).** The 100BASE-FX ports shall support FEFI.

(aa) **Dual Power Supplies.** The device shall have dual redundant power supply.

(bb) **Suitable for Harsh Environments.** The device shall meet IEEE 1613 Class 1, IEC 61850-3, and IEC 60255 standards.

(cc) **Reliability.** The manufacturer shall supply the actual measured mean time between failures (MTBF) for the device upon request.

(dd) **Service.** The device shall include no-cost technical support for the life of the product.

(ee) **Manufacturer.** The device shall be manufactured in the United States, Canada or western Europe by reputable industrial computer manufacturers such as SEL, ABB or Siemens

(ff) **Conformal Coating.** The device shall have optional conformal coating to protect the circuit boards from harsh environments.

(gg) **Warranty.** The device shall include a ten-year warranty for all material and workmanship defects.

### 5.4.1.4.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switch type</td>
<td>Managed Ethernet Switch</td>
</tr>
<tr>
<td>2</td>
<td>Switching Method:</td>
<td>Store and Forward</td>
</tr>
<tr>
<td>3</td>
<td>Switching Latency:</td>
<td>&lt;7 µs</td>
</tr>
<tr>
<td>4</td>
<td>Switch Throughput:</td>
<td>≥19.2 Gbps</td>
</tr>
<tr>
<td>5</td>
<td>Priority Queues:</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Maximum VLANs:</td>
<td>≥4094</td>
</tr>
<tr>
<td>7</td>
<td>MAC Address Table Size:</td>
<td>≥8192 addresses</td>
</tr>
<tr>
<td>8</td>
<td>Processor Speed</td>
<td>≥300 MHz</td>
</tr>
<tr>
<td>9</td>
<td>Memory</td>
<td>≥512 MB</td>
</tr>
<tr>
<td>10</td>
<td>Storage</td>
<td>≥512 MB</td>
</tr>
<tr>
<td>11</td>
<td>Network Management</td>
<td>(i) HTTPS Web User Interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) SNMP v1/v2c/v3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Settings Import/Export</td>
</tr>
<tr>
<td>12</td>
<td>Key Protocol and functions</td>
<td>(i) IEEE 802.1Q-2005 VLAN and Priority Tagging Class of Service (CoS)</td>
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<td>Support</td>
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<tr>
<td>No.</td>
<td>Feature</td>
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<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>local syslog messages Storage</td>
<td>≥ 60,000 messages</td>
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<tr>
<td>14</td>
<td>Total number of rear ethernet ports</td>
<td>≥ 24</td>
</tr>
<tr>
<td>15</td>
<td>Total number 1GB Base-T Ethernet ports (RJ45)</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>16</td>
<td>Total number 1Gb SFP Ethernet ports</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>17</td>
<td>100 Base-FX SFP modules with LC connectors</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>18</td>
<td>Total number 1Gb Base-T or 100Mb Base-TX Ethernet ports (RJ45)</td>
<td>≥ Sixteen (16)</td>
</tr>
<tr>
<td>19</td>
<td>LAN ethernet ports position</td>
<td>Rear</td>
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<tr>
<td>20</td>
<td>Management ethernet ports</td>
<td>≥ One (1)</td>
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<tr>
<td>21</td>
<td>Front side LED’s</td>
<td>(i) ≥ 24 port status LED</td>
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<tr>
<td></td>
<td></td>
<td>(ii) Two power supply status LED’s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Device status LED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iv) Alarm status LED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(v) Lamp test push button</td>
</tr>
<tr>
<td>22</td>
<td>Alarm Output Contact</td>
<td>≥ One (1) Form C (SPDT) relay contact</td>
</tr>
<tr>
<td>23</td>
<td>Alarm Output Contact rating</td>
<td>≥ 250 Vac/Vdc &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 5A continuous</td>
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<tr>
<td>24</td>
<td>Alarm Output Contact wiring</td>
<td>Terminal blocks</td>
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<td>25</td>
<td>Power supply type</td>
<td>Hot swappable, dual redundant power supply (1+1)</td>
</tr>
<tr>
<td>26</td>
<td>Number of hot plug Power supply units</td>
<td>Two (2)</td>
</tr>
<tr>
<td>27</td>
<td>Power rating of each power supply unit</td>
<td>≥ 45W</td>
</tr>
</tbody>
</table>
No. | Feature | Requirements
--- | --- | ---
28 | Power input rating | 110–240V AC, 50Hz & 100–250V DC
29 | Power supply connections | Terminal blocks
30 | Enclosure type | Steel or metallic equivalent
31 | Enclosure Protection as per IEC 60529 | ≥IP20
32 | Mounting: | Rack type
33 | Form factor (fully configured): | 1U
34 | Device Cooling | Natural, heat sink or solid state
35 | Continuous ambient operating temperature | −5° C to +60°C
36 | Operating Relative Humidity (non-condensing) | 0 to 95%
37 | Operating altitude without derating | ≥2000 m
38 | Operating Environment | Pollution Degree: 2
 | | Overvoltage Category: II
 | | Insulation Class: I
39 | Manufacturer Warranty | 10 years

5.4.1.4.3 **Type tests**

The industrial ethernet switch shall have been type tested and passed the following type tests. Type test report/certificate to be attached with the bid offer:

(a) Communication Product Testing
   (i) IEEE 1613-2009, Class 1, KEMA certified
   (ii) IEC 61850-3:2013, KEMA certified
   (iii) IEC 61850-90-4, KEMA certified

(b) Electromagnetic Compatibility Emissions
   (i) Generic Emissions:
      - EN 60255-26:2013
      - EN 61850-3:2014
      - 47 CFR Part 15
      - ICES-003, Issue 6
      - CISPR 11:2009 + A1:2010
CISPR 22:2008
EN 55011:2009 + A1:2010
EN 55022:2010 + AC:2011
EN 55023:2012 + AC:2013

Severity Level: Class A

(c) Electromagnetic Compatibility Immunity

(i) Conducted RF Immunity:
- IEC 60255-26:2013
- IEC 61000-4-6:2008

Severity Level: 10 Vrms

(ii) Electrostatic Discharge Immunity:
- IEC 60255-26:2013
- IEC 61000-4-2:2008
- IEEE C37.90.3-2001

Severity Level: 2, 4, 8 kV contact; 4, 8, 15 kV air

(iii) Fast Transient/Burst Immunity:
- IEC 60255-26:2013
- IEC 61000-4-4:2011

Severity Level: Zone A

(iv) Magnetic Field Immunity:
- IEC 60255-26:2013
- IEC 61000-4-8:2009

Severity Level: 1000 A/m for 3 seconds, 100 A/m for 1 minute
- IEC 61000-4-9:2001

Severity Level: 1000 A/m
- IEC 61000-4-10:2001

Severity Level: 100 A/m

(v) Power Supply Ripple:
- IEC 60255-26:2013
- IEC 61000-4-17:2008

(vi) Power Supply Dips and Interruptions:
- IEC 60255-26:2013
- IEC 61000-4-11:2004
- IEC 61000-4-29:2000

(vii) Power Supply Gradual Shutdown and Start-up:
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

- IEC 60255-26:2013

(viii) Power Supply Discharge Capacitors:
- IEC 60255-27:2013

(ix) Power Supply Reverse Polarity and Slow Ramp:
- IEC 60255-27:2013

(x) Radiated RF Immunity:
- IEC 60255-26:2013

Severity Level: 10 V/m unmodulated 80 MHz–1 GHz, 1.4 GHz–2.7 GHz
- IEEE C37.90.2-2004

Severity Level: 20 V/m 80% AM, 0.5 s keyed, 80 MHz–1 GHz

(xi) Surge Immunity:
- IEC 60255-26:2013
- IEC 61000-4-5:2005

Severity Level: Zone A

(xii) Surge Withstand Capability:
- IEC 60255-26:2013

Severity Level: 2.5 kV peak common mode, 1.0 kV peak differential mode
- IEC 61000-4-18:2006
- IEEE C37.90.1-2002

Severity Level: 2.5 kV oscillatory, 4 kV fast transient waveform

(d) Environmental

(i) Cold:
- IEC 60255-27:2013
- IEC 60068-2-1:2007

Severity Level: 16 hours at –40°C

(ii) Dry Heat:
- IEC 60255-27:2013
- IEC 60068-2-2:2007

Severity Level: 16 hours at +85°C

(iii) Damp Heat, Cyclic:
- IEC 60255-27:2013
- IEC 60068-2-30:2005

Severity Level: 25°C to 55°C
Relative Humidity: 93% to 95%
Duration: 6 cycles, 1 cycle/day

(iv) Damp Heat, Steady State:
Ten tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

- IEC 60255-27:2013
- IEC 60068-2-78:2002

Severity Level: 40°C
Relative Humidity: 93%
Duration: 4 days
(v) Vibration
- IEC 60255-27:2013
- IEC 60255-21-1:1988
Severity Level: Class 1 endurance, Class 2 response
- IEC 60255-21-2:1988
Severity Level: Class 1 - shock withstand, bump, and Class 2 - shock response
- IEC 60255-21-3:1993
Severity Level: Class 2 (quake response)
(e) Safety
(i) Dielectric Strength:
- IEC 60255-27:2013
- IEEE C37.90-2005
3600 Vdc on power supply and alarm contact; 2250 Vdc on Ethernet ports
Type tested for 1 minute
- IEEE 802.3-2012
  — 2250 Vdc on electrical Ethernet ports
  — Type tested for 1 minute
  — 1GbE ports comply with Environment A requirements between ports
  — 100MbE ports comply with Environment B requirements between ports
(ii) Impulse:
- IEC 60255-27:2013
- IEEE C37.90-2005
Severity Level:
  — Common Mode
  5 kV power supply, alarm contact
2.4 kV Ethernet Ports
  — Common Mode, Port to Port
  5 kV power supply, alarm contact
Zero-Rated, Ethernet ports

(iii) Protective Bonding Resistance:
- IEC 60255-27:2013
- IEEE C37.90-2005

5.4.1.5 **PTP Grandmaster clock/Time server**

5.4.1.5.1 **General Requirements**

(a) **Satellite Signals for Time Input. With a GNSS antenna**, the device shall receive signals from GPS and GLONASS and, when configured, use GLONASS information to verify the GPS signals.

(b) **BNC Ports.** The device shall include eight standard BNC outputs, all of which can be configured individually for demodulated IRIG-B, PPS or kPPS. As many as four of the BNC ports can be configured for modulated IRIG-B.

(c) **Demodulated IRIG-B.** The device shall provide nine demodulated IRIG-B or pulse output with an average accuracy of ±40 ns to UTC and a peak accuracy of ±100 ns to UTC.

(d) **Modulated IRIG-B.** The device shall provide as many as four modulated IRIG-B ports with a peak accuracy of ±1 µs to UTC.

(e) **Ethernet Ports.** The device shall include four standard Ethernet ports on the rear that are Two (2) 10/100BASE-T standard and two (2) single-mode or multimode LC fibre ports.

(f) **Parallel Redundancy Protocol (PRP).** The device shall support PRP operation. When enabled, Ethernet Port 1 and Port 2 will combine to act as a dual attached node device on a PRP network.

(g) **PTP Grandmaster.** The device shall act as a PTP Grandmaster Clock with Default and Power System profiles. The device shall serve PTP time on as many as four independent networks providing ±100 ns peak time stamp accuracy to UTC.

(h) **NTP Time Serving.** The device shall serve NTPv4 time on as many as four independent networks. NTP peak accuracy shall be ±100 µs to UTC, measured at the output port.

(i) **Holdover.** The device shall include an OCXO oscillator with average accuracy of 5 µs per day at constant or varied temperature between +10°C and +50°C.
(j) **Management Port.** The front Ethernet management port shall support a DHCP server that is enabled by default and can be disabled. The port shall support HTTPS web interface configuration.

(k) **DB-9 Port.** The device shall include one port with DB-9 connector for IRIG-B or pulse output.

(l) **Contact Outputs.** The device shall include one standard Form C alarm contact and one standard Form A Time Contact output with 1 µs accuracy.

(m) **Antenna Cable.** The device shall support a maximum antenna cable length of 152 meters (500 feet) using LMR-400 cable.

(n) **Output Cable.** The device shall support a maximum output cable length of 152 meters (500 feet) using RG-58 cable.

(o) **Cable Delay Compensation.** The device shall allow cable delay compensation for the antenna cable and for time outputs on a per port basis.

(p) **Graphical User Interface (GUI)-Based Secure Management.** The device shall provide a secure HTTPS GUI-based management interface.

(q) **Automated Diagnostics and Reporting.** The device shall monitor health and functions and report state changes.

(r) **Settings Import/Export.** The device shall support importing and exporting device settings.

(s) **Secure Firmware Upgrades.** The device shall support authentication of firmware through digital signatures.

(t) **Nonintrusive Monitoring and Setting.** The device shall provide an Ethernet interface to the HTTPS management port. The management port will be used for configuration settings and monitoring and will be protected with encryption and authentication algorithms.

(u) **User Authentication.** The device shall authenticate and authorize users by using role-based accounts and Lightweight Directory Access Protocol (LDAP).

(v) **Logging.** The device shall log locally and forward event messages across an Ethernet network by using Syslog to as many as three Syslog destinations.

(w) **SNMP.** The device shall use SNMP traps to notify users of certain pre-set conditions, such as GPS loss or security events. The device shall also support SNMP read for monitoring clock diagnostics.

(x) **Dual Power Supplies.** The device shall have dual redundant power supply
(y) **Suitable for Harsh Environments.** The device shall meet IEEE 1613 Class 2, IEC 61850-3, and IEC 60255 standards. The device shall operate within a temperature range of \(-40^\circ\) to \(+85^\circ\)C.

(z) **Reliability.** The vendor shall supply the actual measured Mean Time Between Failures (MTBF) for the device upon request.

(aa) **Service.** The device shall include no-cost technical support for the life of the product.

(bb) **Conformal Coating.** The device shall have optional conformal coating to protect the circuit boards from harsh environments.

(cc) **Warranty.** The device shall include a ten-year warranty for all material and workmanship defects.

### 5.4.1.5.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Satellite Tracking:</td>
<td>GPS &amp; GLONASS and optionally others e.g. Galileo</td>
</tr>
<tr>
<td>2</td>
<td>PPS Clock accuracy (to UTC)</td>
<td>(\leq 40) ns average, (\leq 100) ns peak</td>
</tr>
<tr>
<td>3</td>
<td>Demodulated IRIG-B Clock accuracy (to UTC)</td>
<td>(\leq 40) ns average, (\leq 100) ns peak</td>
</tr>
<tr>
<td>4</td>
<td>Modulated IRIG-B Clock accuracy (to UTC)</td>
<td>(\leq 1) (\mu)s peak</td>
</tr>
<tr>
<td>5</td>
<td>PTP Time-Stamp accuracy (to UTC)</td>
<td>(\leq 100) ns peak</td>
</tr>
<tr>
<td>6</td>
<td>NTP Time-Stamp accuracy (to UTC) (for directly connected devices)</td>
<td>(&lt; 100) (\mu)s</td>
</tr>
<tr>
<td>7</td>
<td>Clock oscillator type</td>
<td>OCXO</td>
</tr>
<tr>
<td>8</td>
<td>OCXO accuracy</td>
<td>(\leq 5) (\mu)s per day ((\pm 1^\circ)C)</td>
</tr>
<tr>
<td>9</td>
<td>Network Management</td>
<td>(iv) HTTPS Web User Interface (v) SNMP v1/v2c/v3 (vi) Settings Import/Export</td>
</tr>
<tr>
<td>10</td>
<td>local syslog messages Storage</td>
<td>(\geq 60,000) messages</td>
</tr>
<tr>
<td>11</td>
<td>Total number of rear ethernet ports</td>
<td>(\geq 4)</td>
</tr>
<tr>
<td>12</td>
<td>Total number of PTP ethernet</td>
<td>(\geq 4)</td>
</tr>
</tbody>
</table>
### Technical Specifications

#### No. | Feature | Requirements
--- | --- | ---
| | | ports |
| 13 | 100 Base-FX ethernet ports with LC connectors | ≥Two (2) |
| 14 | Total number 1Gb Base-T or 100Mb Base-TX Ethernet ports (RJ45) | ≥Two (2) |
| 15 | LAN Ethernet ports position | Rear |
| 16 | Management ethernet ports | ≥One (1) |
| 17 | IRIG-B/PPS BNC ports | ≥Four (4) |
| 18 | IRIG-B serial DB-9 ports | ≥One (1) |
| 19 | Front side LED’s | (i) Four ethernet port status LED’s  
(ii) Two power supply status LED’s  
(iii) Device status LED’s  
(iv) Alarm status LED’s  
(v) Antenna status LED’s  
(vi) Clock sync status LED’s  
(vii) PTP status LED’s  
(viii) NTP status LED’s  
(ix) Lamp test push button |
| 20 | Alarm Output Contact | ≥One (1) Form C (SPDT) relay contact |
| 21 | Alarm Output Contact rating | ≥125/250 Vdc & ≥2A continuous |
| 22 | Timing Contact Output rating | ≥24–250 Vdc |
| 23 | Timing Contact | ≤±1 μs |
| 24 | Output Contact wiring | Terminal blocks |
| 25 | Power supply type | Hot swappable, dual redundant power supply (1+1) |
| 26 | Number of hot plug Power supply units | Two (2) |
| 27 | Power rating of each power supply unit | ≥ 45W |
| 28 | Power input rating | 110–240V AC, 50Hz & 100–250V DC |
| 29 | Power supply connections | Terminal blocks |
Ten

der for supply of SCADA hardware for seven forks & Turkwel hydroelectric power
plants

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Enclosure type</td>
<td>Steel or metallic equivalent</td>
</tr>
<tr>
<td>31</td>
<td>Enclosure Protection as per IEC 60529</td>
<td>≥IP20</td>
</tr>
<tr>
<td>32</td>
<td>Mounting;</td>
<td>Rack type</td>
</tr>
<tr>
<td>33</td>
<td>Form factor (fully configured):</td>
<td>1U</td>
</tr>
<tr>
<td>34</td>
<td>Device Cooling</td>
<td>Natural, heat sink or solid state</td>
</tr>
<tr>
<td>35</td>
<td>Continuous ambient operating temperature</td>
<td>–5°C to +60°C</td>
</tr>
<tr>
<td>36</td>
<td>Operating Relative Humidity (non-condensing)</td>
<td>0 to 95%</td>
</tr>
<tr>
<td>37</td>
<td>Operating altitude without derating</td>
<td>≥2000 m</td>
</tr>
<tr>
<td>37</td>
<td>Operating Environment</td>
<td>Pollution Degree: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overvoltage Category: II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insulation Class: I</td>
</tr>
<tr>
<td>38</td>
<td>Manufacturer Warranty</td>
<td>10 years</td>
</tr>
</tbody>
</table>

5.4.1.5.3 **Antenna**

(a) Antenna and all related accessories shall be supplied

(b) Accessories shall include but not limited to

(i) High gain omni directional IP67 Antenna,

(ii) surge protector

(iii) all connector cables

• at least 10-meter cable between the receiver and the surge protector

• at least 50-meter cable between the surge protector and the antenna

• All required cable connectors

(iv) all necessary Antenna mounting brackets and accessories

5.4.1.5.4 **Type tests**

The industrial clock and time server shall have been type tested and passed the following type tests. Type test report/certificate to be attached with the bid offer.

(a) Communication Product Testing
(i) Communications for Substation Equipment:
   - IEEE 1613-2009
   - Class 2

(ii) Power Frequency Disturbances:
   - IEC 61850-3:2002

(b) Electromagnetic Compatibility
   (i) General Measuring Relays and Protection Equipment:
      - IEC 60255-26:2013

(c) Electromagnetic Compatibility Emissions
   (i) Radiated RF Emissions:
      - IEC 60255-25:2000
      Severity Level: Class A
   (ii) Conducted RF Emissions:
      - IEC 60255-25:2000
      - FCC 15.107:2014
      Severity Level: Class A
   (iii) Telecom Conducted RF Emissions:
      - EN 55022:2010
      Severity Level: Class A

(d) Electromagnetic Compatibility Immunity
   (i) Conducted RF Immunity:
      - IEC 60255-22-6:2001
      - IEC 61000-4-6:2008
      Severity Level: 10 Vrms
   (ii) Radiated RF Immunity:
      - IEC 60255-22-3:2007
      - IEC 61000-4-3:2008
      Severity Level: 10 V/m
      - IEEE C37.90.2-2004
      Severity Level: 35 V/m
   (iii) Electrostatic Discharge Immunity:
      - IEC 61000-4-2:2008
      Severity Level: ±2, 4, 6, 8 kV contact; ±2, 4, 8, 15 kV air
• IEEE C37.90.3-2001

Severity Level: ±2, 4, and 8 kV contact; ±4, 8, and 15 kV air

(iv) Surge Withstand Capability:
• IEC 60255-22-1:2007

Severity Level: ±2.5 kV peak common mode, ±1.0 kV peak differential mode

• IEEE C37.90.1-2002

Severity Level: ±2.5 kV, 1 MHz oscillatory; ±4 kV, 2.5 kHz fast transient

(v) Fast Transient/Burst Immunity:
• IEC 60255-22-4:2008
• IEC 61000-4-4:2011

Severity Level: ±4 kV, 5 kHz; ±2 kV, 5 kHz on communications ports

(vi) Surge Immunity:
• IEC 60255-22-5:2008
• IEC 61000-4-5:2005

Severity Level: ±0.5 kV, 1 kV line-to-line, ±0.5 kV, 2 kV line-to-earth; ±0.5 kV, 1 kV line-to-earth on communications ports

(vii) Power Frequency Magnetic Field Immunity:
• IEC 61000-4-8:2009

Severity Level: 1000 A/m for 3 seconds, 100 A/m for 1 minute

(viii) Pulse Magnetic Field Immunity:
• IEC 61000-4-9:2001

Severity Level: 1000 A/m

(ix) Damped Oscillatory Magnetic Field Immunity:
• IEC 61000-4-10:2001

Severity Level: 100 A/m (at 1 kHz and 1 MHz)

(x) Power Supply Immunity:
• IEC 60255-11:2008
• IEC 61000-4-11:2004
• IEC 61000-4-17:2002
• IEC 61000-4-29:2000

(e) Environmental

(i) Cold:
• IEC 60068-2-1:2007

Severity Level: 16 hours at –40°C

(ii) Damp Heat, Cyclic:
• IEC 60068-2-30:2005
Severity Level: 25° to 55°C, 6 cycles, relative humidity: 95%
(iii) Dry Heat:
  • IEC 60068-2-2:2007
Severity Level: 16 hours at +85°C
(iv) Free Fall:
  • IEEE 1613-2009
Severity Level: 100 mm
(v) Vibration:
  • IEC 60255-21-1:1988
Severity Level: Class 2 Endurance
Class 2 Response Shock & Bump:
(vi) IEC 60255-21-2:1998
  • Severity Level:
    — Class 1 Shock Withstand
    — Class 1 Bump
    — Class 2 Shock Response
(vii) Seismic:
  • IEC 60255-21-3:1993
Severity Level: Class 2 (Quake Response)
(f) Safety
(i) Measuring Relays and Protection Equipment:
  • IEC 60255-27:2013
(ii) Protection IP Code:
  • IEC 60529:2001
IP Code: IP3X for category 2 equipment
(iii) Insulation Coordination:
  • IEC 60255-5:2000
  • IEEE C37.90-2005
Dielectric (HiPot) Severity Level:
  — Power Supply: 3100 Vdc
  — Alarm Contact: 2500 Vac
  — IRIG-B Input: 2100 Vdc
  — Ethernet Ports: 1500 Vac
  — Timer Contact (OUT1): 3500 Vdc
Impulse Severity Level:
5.4.1.6 **DCF77 Time code Output converter**

5.4.1.6.1 Contractor shall supply and install IRIG-B /PTP to DCF77 time synchronisation signal converter such as *STR-100 by cyber sciences* or any other meeting requirements for time synchronisation of procuring entity PLC’s

5.4.1.6.2 A DCF77 Time code Output converter shall be supplied installed into each of the LCC panels. Shall be DIN mounted or panel mounted.

5.4.1.6.3 The DCF77 24V DC time code output shall be compatible with Schneider Modicon Quantum 140 ERT 854-10-time sync input that are used by the procuring entity.

5.4.1.6.4 Sixteen devices shall be daisy chained (by the procuring entity) to the 24V DC DCF77 time code outputs of the converter.

5.4.1.6.5 Each DCF77 time code output converter shall have a minimum of the following

(a) A BNC/serial IRIG-B time source input or an ethernet PTP time source input

(b) 24V DC DCF77-time pulses output for connection to at least sixteen devices in a daisy chain.

(c) DCF77 time output accuracy of at least ±100 µs to the input reference

(d) 110V DC to 24V DC power supply unit

(e) Cables for connecting to the grandmaster clock

5.4.1.6.6 The DCF77 time code output converter shall be connected to the PTP grandmaster clock IRIG-B or ethernet PTP time outputs by the contractor, all cables and accessories necessary for this shall be provided

5.4.1.6.7 The converter shall be connected to the time source, configured and tested prior to FAT. The converter shall be configured by the contractor to synchronise Modicon 140 ERT 85410, all necessary configuration shall be carried out by the contractor.

5.4.1.6.8 The DCF77 time code output converter shall meet the following minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCF77 output Voltage range</td>
<td>11 to 28 Vdc (24 Vdc nominal)</td>
</tr>
<tr>
<td>2</td>
<td>DCF77 output Pulse rate (per DCF77 standard)</td>
<td>1 pulse-per-second (1PPS), accuracy = ±50 microseconds</td>
</tr>
<tr>
<td>3</td>
<td>Power supply</td>
<td>110V DC directly or through an externa PSU</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Operating temperature</td>
<td>-30 to +50° C</td>
</tr>
<tr>
<td>5</td>
<td>Storage temperature</td>
<td>-40 to +85° C</td>
</tr>
<tr>
<td>6</td>
<td>Humidity rating</td>
<td>5% to 95% relative humidity</td>
</tr>
<tr>
<td>7</td>
<td>Product certifications</td>
<td>UL listed (UL-508), cUL (CSA C22.2), CE mark</td>
</tr>
<tr>
<td>8</td>
<td>Electromagnetic interference / immunity</td>
<td>As per standards below</td>
</tr>
<tr>
<td>9</td>
<td>● Radiated emissions</td>
<td>EN 55022 / FCC class A</td>
</tr>
<tr>
<td>10</td>
<td>● Conducted emissions</td>
<td>EN 55022 / FCC class A</td>
</tr>
<tr>
<td>11</td>
<td>● Immunity for industrial</td>
<td>EN 61000-6-2</td>
</tr>
<tr>
<td>12</td>
<td>● Electrostatic discharge (air discharge)</td>
<td>EN 61000-4-2</td>
</tr>
<tr>
<td>13</td>
<td>● Immunity to surge (impulse wave)</td>
<td>EN 61000-4-5</td>
</tr>
<tr>
<td>14</td>
<td>● Immunity to electrical fast transients</td>
<td>EN 61000-4-4</td>
</tr>
<tr>
<td>15</td>
<td>● Power frequency magnetic field</td>
<td>EN 61000-4-8</td>
</tr>
<tr>
<td>16</td>
<td>● Voltage dips / voltage interruptions</td>
<td>EN 61000-4-11</td>
</tr>
<tr>
<td>17</td>
<td>● Conducted immunity</td>
<td>EN 61000-4-6</td>
</tr>
<tr>
<td>18</td>
<td>● Radiated immunity</td>
<td>EN 61000-4-3</td>
</tr>
</tbody>
</table>

5.4.1.7 **Industrial Grade LCD Touch Monitor**

5.4.1.7.1 Shall be connected to the industrial PC’s and the thin client PC via KVM

5.4.1.7.2 At minimum it shall have two Video inputs an audio output and an audio input

5.4.1.7.3 The monitors shall be industrial grade hardened for operation at continuous temperature of between 5°C – 40°C, vibration and relative humidity.

5.4.1.7.4 Shall be supplied complete with all accessories, features and devices required for operation and configuration of a computer monitor, connection to the KVM switches and power outlets and mounting/positioning brackets and accessories irrespective of whether these components are stated in these schedules or not.

5.4.1.7.5 Shall meet the following minimum specifications:

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel size</td>
<td>19.0 inch</td>
</tr>
<tr>
<td>2</td>
<td>Native resolution</td>
<td>≥ 1280 x 1080</td>
</tr>
<tr>
<td>3</td>
<td>brightness</td>
<td>≥250cd/m²</td>
</tr>
</tbody>
</table>
### Technical Specifications

**Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants**

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Contrast ratio</td>
<td>( \geq 1000:1 )</td>
</tr>
<tr>
<td>5</td>
<td>Viewing angle</td>
<td>( \geq 178^\circ (V) / 178^\circ (H) )</td>
</tr>
<tr>
<td>6</td>
<td>Display colours</td>
<td>( \geq 16.7 \text{ M (True 8bit)} )</td>
</tr>
<tr>
<td>7</td>
<td>Number of Video input ports</td>
<td>( \geq \text{Two (2)} )</td>
</tr>
<tr>
<td>8</td>
<td>Touch screen type</td>
<td>5-wire resistive system and USB interface to host computer</td>
</tr>
<tr>
<td>9</td>
<td>Backlight</td>
<td>LED</td>
</tr>
<tr>
<td>10</td>
<td>Continuous operating temperature</td>
<td>( 0^\circ \text{ to } 50^\circ )</td>
</tr>
<tr>
<td>11</td>
<td>Relative humidity, non-condensing</td>
<td>( \text{20% to 90%} )</td>
</tr>
<tr>
<td>12</td>
<td>Operating Shock</td>
<td>( \geq 15 \text{ g, 6 msec, half-sine} )</td>
</tr>
<tr>
<td>13</td>
<td>Operating Vibration</td>
<td>( \geq 1.0 \text{g, swept sine 9 – 500 Hz} )</td>
</tr>
<tr>
<td>14</td>
<td>Rated operating altitude</td>
<td>( \geq 2000 \text{ m} )</td>
</tr>
<tr>
<td>15</td>
<td>Power supply</td>
<td>Internal 220-240V AC, 50Hz power supply unit.</td>
</tr>
<tr>
<td>16</td>
<td>Power supply Cord</td>
<td>C13 or C14 to BS1363 (IEC type G-British type) plug</td>
</tr>
<tr>
<td>17</td>
<td>Base and support brackets</td>
<td>Robust steel construction.</td>
</tr>
<tr>
<td>18</td>
<td>Screen Protector</td>
<td>To be provided</td>
</tr>
<tr>
<td>19</td>
<td>Front monitor Protection as per IEC</td>
<td>IP66</td>
</tr>
<tr>
<td></td>
<td>60529</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Front Bezel</td>
<td>Steel finish</td>
</tr>
</tbody>
</table>

#### 5.4.1.8 Four port KVM switch

**5.4.1.8.1 General Requirements**

(a) At minimum it shall have four host Video inputs and one console video output. Four console USB outputs and four host USB input.

(b) The switch will be installed at the LCC panel for connecting the industrial PC’s and the thin client PC to the industrial touch monitor, keyboard and mouse.

(c) The KVM switch video inputs MUST be compatible with the industrial PC and thin client PC display outputs.
(d) The KVM switch shall support touch input from the touch Monitor to the connected devices in a similar fashion to a mouse.

(e) Each KVM switch shall contain a console port for configuration and management. If software is required for configuration of the switch it MUST be provided.

(f) KVM switch shall be panel mounted or DIN mounted or rack mounted into the LCC panels

(g) KVM switches shall be supplied complete with all accessories, features and devices required for connection of touch monitors, keyboard & mouse to four host PC’s irrespective of whether these components are stated in these specifications or not.

(h) The offered KVM switches shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
   (i) Temperature: 0 to 40°C (continuous)
   (ii) Altitude: ≥ 1000mASL
   (iii) Installation location: indoor with natural aeration only

5.4.1.8.2 Minimum specifications

Shall meet the following

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of host computer input connections</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>2</td>
<td>Number of video inputs</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>3</td>
<td>Number of displays supported</td>
<td>≥ One (1)</td>
</tr>
<tr>
<td>4</td>
<td>Maximum video resolution supported</td>
<td>≥ 1920 x 1200@60Hz</td>
</tr>
</tbody>
</table>
| 5  | Type of display ports supported by the switch | DVI or DP or HDMI  
   (the type of video input and output ports MUST be compatible with the KVM extender video outputs, bidder to specify ports on offer) |
<p>| 6  | Number USB input ports                       | ≥ Four (4), one per PC input.                    |
| 7  | Number of USB ports on the KVM switch for connection of keyboard, mouse and | ≥ Four (4)                                       |</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>USB type supported</td>
<td>USB 2.0 &amp; USB 1.1 must be supported</td>
</tr>
<tr>
<td>9</td>
<td>Output (console) Audio terminals</td>
<td>Two 3.5mm audio in and two 3.5mm audio out</td>
</tr>
<tr>
<td>10</td>
<td>Input (host) Audio terminals</td>
<td>Four 3.5mm audio in and four 3.5mm audio out</td>
</tr>
<tr>
<td>11</td>
<td>Port selection</td>
<td>Hotkey, Pushbutton</td>
</tr>
<tr>
<td>12</td>
<td>LEDs Device On</td>
<td>One (1) Green</td>
</tr>
<tr>
<td>13</td>
<td>LEDs Video input on Line /Selected</td>
<td>Four (4) Red and Four (4) Green</td>
</tr>
<tr>
<td>14</td>
<td>Power supply</td>
<td>220-240V AC, 50Hz internal or external power supply unit.</td>
</tr>
<tr>
<td>15</td>
<td>Power supply Cord</td>
<td>C13 or C14 to BS1363 (IEC type G-British type) plug</td>
</tr>
<tr>
<td>16</td>
<td>Operating temperature</td>
<td>0 to 40°C continuous</td>
</tr>
<tr>
<td>17</td>
<td>Casing/Enclosure</td>
<td>Robust steel construction.</td>
</tr>
<tr>
<td>18</td>
<td>Mounting:</td>
<td>Panel or DIN or rack</td>
</tr>
<tr>
<td>19</td>
<td>Manufacturer Warranty</td>
<td>Three (3) years</td>
</tr>
</tbody>
</table>

### 5.4.1.8.3 Product Certifications

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided.

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

### 5.4.2 SCADA RCC SERVER CABINETS EQUIPMENT

#### 5.4.2.1 General Requirements

##### 5.4.2.1.1 Cabinets Layout

(a) Two server cabinets shall be supplied with all the equipment as detailed in the scope of supply installed and configured.

(b) All cubicle, electrical and networking accessories shall be provided for and installed as detailed in clause 5.4.2.10 – clause 5.4.2.11.
(c) The contractor shall supply, assemble, configure and test all the cabinet equipment prior to factory acceptance testing witnessed by the procuring entity.

(d) RCC DMZ server cabinet equipment shall contain the following minimum number of ports and maximum device mounting rack units:

<table>
<thead>
<tr>
<th>No</th>
<th>Equipment/part Description</th>
<th>Qty</th>
<th>Maximum Rack units for each device</th>
<th>Minimum RJ45 ethernet ports on each device</th>
<th>Power supply units on each device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rack mount VM Host Servers</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Rack mount Network Attached Storage</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Rack mount Workstations</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Rack mount enterprise security appliance/gateway</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Cisco Ethernet Switches</td>
<td>2</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Rack mount Integrated console monitor, keyboard &amp; 16 port KVM switch</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Rack mount Sixteen Outlet (C13), 240 V AC, 32A PDU</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>RJ45, Cat7, 24 port, shielded Patch panels</td>
<td>6</td>
<td>2</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>24 port rack mount Fibre optic patch panels (LC)</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

(e) RCC Operations server cabinet equipment shall contain the following minimum number of ports and maximum device mounting rack units:

<table>
<thead>
<tr>
<th>No</th>
<th>Equipment/part Description</th>
<th>Qty</th>
<th>Maximum Rack units for each device</th>
<th>Minimum RJ45 ethernet ports on each device</th>
<th>Power supply units on each device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rack mount VM Host Servers</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Rack mount Workstations</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>
5.4.2.1.2 **Cabinet design**

(a) Electrical wiring and networking of the panel shall be carried out as per approved drawings.

(b) Bidder shall design panel electrical schematic drawing based on the tender specifications, OEM requirements and any other requirements necessary for optimal operation of the cabinet and cabinet mounted equipment. The drawing shall be submitted for review and approval as detailed in clause 5.1.7.

(c) During design, contractor shall ensure all requirements of the OEM for optimal operation of the equipment have been met. All components and accessories proscribed by the OEM for optimal operation of the mounted equipment shall be provided for and installed by the contractor irrespective of whether such devices have been included in the tender specifications.

(d) Panel structural drawing and panel layout drawings showing device placement shall carried out by the contractor and submitted for approval as detailed in clause 5.1.7.

(e) All electrical equipment shall be protected from electrical faults such as short circuits as per the OEM specifications. Devices such as fuses, MCB’s etc shall be included for device protection.

(f) Sizing of electrical protection devices such as MCB’s shall be carried out as per requirements in clause 5.3.3 and OEM requirements.
(g) Electrical equipment shall utilise nominal auxiliary supply of 110V DC - 125VDC or 220V AC-240 VAC as detailed in clause 5.3.3. power supply units meeting requirements in clause 5.3.3.5 shall be installed in the cabinet for supply of power to devices requiring any other auxiliary power supply other than the one specified above, irrespective of whether

(h) Electrical wiring cables and conductors shall meet OEM requirements and requirements in clause 5.3.6 and 5.3.7

(i) Cubicle shall be installed in an environment with average temperature of 35°C. The equipment in the cabinet shall be designed for continuous operation at this temperature without derating and external forced cooling.

(j) Two redundant (1+1) fans rated for a minimum of 750m³/hour air flow rate shall be installed at roof of the cabinets to improve cabinet cooling and extend the life of the installed equipment. However, the panel shall be designed for operation without the fans.

(k) Cabinet materials shall meet the requirements of clause 5.3.2. Cabinet design shall meet the requirements of clause 5.3.6 and all the requirements of clause 5.4.2.6

(l) All external cables shall terminate to a terminal block or a patch panel. All cabinet devices ports and terminals shall be wired/connected to patch panels or terminal blocks for connection to external cables during installation by the procuring entity.

(m) All ethernet ports of equipment mounted in the cabinets shall be connected to the patch panels. Ethernet connections between devices on the cabinets shall be via patch panel ports but not directly between device to device except for fibre optic patch cords which shall be connected directly between devices.

(n) Ethernet twisted pair patch panels shall be rack mounted on the front side of the cabinets and panel mounted or DIN rail mounted at the rear side of the panel. The cabinet wiring shall be very neat and shall allow easy access of the internal equipment.

(o) All networking cables shall be guided around the cabinet using cable managers (cable trunks) and t

5.4.2.1.3 System Architecture

(a) The equipment shall be connected as shown the specification drawing

(b) There shall be two management host servers one each cabinet, four production host servers two in each cabinet and two Network Attached Storage servers on the DMZ cabinet
(c) The two management `host servers shall host applications dedicated to management of SCADA assets while the production host servers shall host applications required for SCADA power plant operations.

(d) All operating systems to be installed into the servers shall be installed as virtual machines

(e) All the servers and workstation in each cabinet shall be connected to the console KVM switch for local administration.

(f) Production host servers shall be redundant. Each pair of servers in one cabinet shall be similar in all manner. The applications to be installed shall have failover between the server’s virtual machines.

5.4.2.2 Host Servers Hardware Specifications

5.4.2.2.1 General requirements

(a) A total of six (6) host servers shall be supplied and installed in the server cabinets

(b) Servers shall be assembled into the cabinets by the bidder and shall be delivered to site in a completely assembled cabinet. All devices and components required to assemble the servers into the cabinet shall be supplied by the bidder irrespective of whether they are stated in the schedules or not.

(c) Servers offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted server computer irrespective of whether these features have been specified in these schedules or not.

(d) The servers supplied will be used by employer to operate industrial control systems

(e) The offered servers shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
   (i) Temperature: 5 to 35°C (continuous)
   (ii) Altitude: ≥ 1000mASL
   (iii) Installation location: indoor with natural aeration only

5.4.2.2.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Intel® Xeon® Gold series or</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>No of processors &amp; sockets</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>3</td>
<td>No of cores on each processor</td>
<td>≥Eighteen (18)</td>
</tr>
<tr>
<td>4</td>
<td>No of threads on each processor</td>
<td>≥Thirty-six (36)</td>
</tr>
<tr>
<td>5</td>
<td>Processor Base Frequency</td>
<td>≥ 3.0GHz</td>
</tr>
<tr>
<td>6</td>
<td>L3 Cache</td>
<td>≥ 24MB</td>
</tr>
<tr>
<td>7</td>
<td>Ultra-Path Interconnect speed</td>
<td>3@10.4 GT/s</td>
</tr>
<tr>
<td>8</td>
<td>Processor TDP</td>
<td>≤200W</td>
</tr>
<tr>
<td>9</td>
<td>RAM type</td>
<td>DDR4 Registered (RDIMM) 2666MT/s</td>
</tr>
<tr>
<td>10</td>
<td>Number of RAM RDIMM slots</td>
<td>Twenty-four (24)</td>
</tr>
<tr>
<td>11</td>
<td>Speed and type of installed RAM modules</td>
<td>RDIMM 2666MT/s</td>
</tr>
<tr>
<td>12</td>
<td>No of installed RAM modules</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>13</td>
<td>Size of each Installed RAM module</td>
<td>≥ 32GB</td>
</tr>
<tr>
<td>14</td>
<td>Total installed RAM</td>
<td>≥ 256GB</td>
</tr>
<tr>
<td>15</td>
<td>Storage drives bay:</td>
<td>8 SFF chassis on the front side, for hot swappable drives</td>
</tr>
<tr>
<td>16</td>
<td>RAID &amp; Storage controller</td>
<td>12GB/s SAS with mixed HDD &amp; SSD support</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(bidder to state exact controller model and type on offer)</em></td>
</tr>
<tr>
<td>17</td>
<td>Type of installed drives</td>
<td>Hot plug SFF, SAS, 12G, 2.5-inch, mixed use SSD drives</td>
</tr>
<tr>
<td>18</td>
<td>Size of each installed SSD drives:</td>
<td>≥ 960GB</td>
</tr>
<tr>
<td>19</td>
<td>Number of installed SSD drives:</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>20</td>
<td>Total SSD storage size</td>
<td>≥ 1.92TB</td>
</tr>
<tr>
<td>21</td>
<td>SSD cell type</td>
<td>SLC or eMLC</td>
</tr>
<tr>
<td>22</td>
<td>SSD minimum endurance rating</td>
<td>≥ 3 DWPD (writes per day) &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 5200 TBW (Terabytes Written)</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Internal optical drive</td>
<td>One (1) DVD+/-RW drive</td>
</tr>
<tr>
<td>24</td>
<td>Network controllers</td>
<td>One (1) dual port 10Gb Base-T Ethernet controller and Two (2) four port 1Gb Base-T Ethernet controller <em>(bidder to state exact controllers’ model and type on offer)</em></td>
</tr>
<tr>
<td>25</td>
<td>Total number 10Gb Base-T Ethernet ports (RJ45)</td>
<td>≥Two (2)</td>
</tr>
<tr>
<td>26</td>
<td>Total number 1Gb Base-T Ethernet ports (RJ45)</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>27</td>
<td>PCIe Expansion slots- PCIe X8, X16</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>28</td>
<td>USB ports</td>
<td>≥ Two (2) rear ports &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ Two (2) front ports</td>
</tr>
<tr>
<td>29</td>
<td>USB 3.0 ports</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>30</td>
<td>Video ports:</td>
<td>≥ one (1) DVI/DP rear port and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ one (1) 1 VGA/HDMI/DP front port                                          <em>(The chosen ports MUST be supported by the KVM switch offered. Bidder to state the exact ports on offered server)</em></td>
</tr>
<tr>
<td>31</td>
<td>Power supply type</td>
<td>Hot plug, dual redundant power supply (1+1)</td>
</tr>
<tr>
<td>32</td>
<td>Number of hot plug Power supply units</td>
<td>Two (2)</td>
</tr>
<tr>
<td>33</td>
<td>Power rating of each power supply unit</td>
<td>≥ 700W</td>
</tr>
<tr>
<td>34</td>
<td>Power input rating</td>
<td>220-240V AC, 50Hz</td>
</tr>
<tr>
<td>35</td>
<td>Power supply Cord</td>
<td>C13 to C14, PDU Style</td>
</tr>
<tr>
<td>36</td>
<td>Mounting:</td>
<td>Rack type</td>
</tr>
<tr>
<td>37</td>
<td>Form factor (fully configured):</td>
<td>1U or 2U</td>
</tr>
<tr>
<td>38</td>
<td>Operating temperature without derating</td>
<td>0 to 35°C continuous</td>
</tr>
<tr>
<td>39</td>
<td>Mounting accessories</td>
<td>Rack rails and cable management arm</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>40</td>
<td>Manufacturer Warranty</td>
<td>3 years parts, and 3 years basic support</td>
</tr>
</tbody>
</table>

5.4.2.2.3 **Product Certifications**

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

5.4.2.3 **Host Servers Virtualisation Requirements**

5.4.2.3.1 **Server Virtualization general requirements**

(a) The host server shall be a virtual machine container, to host the employers’ HMI servers and other applications. The fundamental aim of the virtualization shall be to allow back up and transfer of all server software and data to another hardware host machine in case of hardware failure with minimal or no changes to the applications.

(b) Each server shall contain latest Enterprise VMware vSphere (ESXi) native (bare metal) Hypervisor operating system installed. The VMware hypervisor shall support all Microsoft windows operating systems from windows server 2019 to windows 1995

(c) Each host server shall contain a minimum of two to four Virtual Machines of Standard Windows server 2012 R2 or Windows server 2016 or windows server 2003 installed on the VMware Hypervisor. Other virtual machines of non-windows operating systems will be installed by the contractor for cyber security server and other applications as detailed in specifications into some host servers

(d) Virtual machines shall be hardware independent; i.e. in case of Hypervisor machine hardware change, the virtual machines shall have to work with the same base features, with no specialist support for the substitution.

(e) Virtualisation and installation of VM’s in all the servers, setting up of the virtualisation management client and the associated virtualisation set up shall be carried out by the bidder.

(f) A workstation computer shall host virtualisation software management client required to manage the virtual machines installed on the servers. The
client software shall allow functions such as manual copying of Vm’s and creation of new Vm’s in the servers.

(g) vCenter server shall be installed to two management host servers for virtual machines monitoring and management.

(h) Contractor shall carry out all necessary configuration and provide any required applications required for regular back up of all VM’s into the NAS.

5.4.2.3.2 Hypervisor minimum requirements

(a) X-based operating system (Unix/Linux)

(b) Remote control, management and configuration capability of the hardware machine and all its virtual machines without mouse, keyboard and monitor direct connections (hypervisor remote control)

(c) NTP time synchronization client: the time synchronization shall be transferred to its own virtual machines

(d) Native RAID5 management capability

(e) All the connected network cards may be directly connected to one of its virtual machines with no virtual driver interposition (“hardware pass-through”)

(f) From the operating point of view, all the running Virtual Machines shall have to be seen as physical computers in the network, even if they are VMs.

5.4.2.3.3 Virtualisation software requirements

(a) A minimum of two (2) 64-bit VMware vSphere essential plus with perpetual licenses shall be supplied and utilised to virtualise all the Host servers in scope of supply

(b) VMware vSphere shall have a minimum of the following features and functions

   (i) vSphere and associated features for six servers
   (ii) Two (2) VCenter server essentials (one per license)
   (iii) Hypervisor
   (iv) vMotion
   (v) High availability
   (vi) Data protection and replication
   (vii) vShield endpoint
   (viii) Two (2) vSphere clients (one per license)

(c) Two (2) vCenter essentials plus (or higher) servers shall be installed into the two management host servers’ windows 2016 server virtual machines, for virtual environment monitoring and management. Supplier shall
configure, test and commission the vCenter functions to allow a minimum following:

(i) Management of VM’s such as configure, provision, monitor, troubleshoot and update virtual environments

(ii) Monitoring of installed VM’s health

(iii) Database server for virtual machine functions

(iv) Perform advanced functions such as vMotion, high availability etc supported by the license

(d) Three (3) year basic software VMware vSphere support shall be provided

5.4.2.4 Host Servers Operating systems Requirements

5.4.2.4.1 General requirements

(a) Contractor shall install all operating systems as virtual machines as detailed in the proceeding clauses. The virtual machines shall be installed, configured and tested prior to factory acceptance tests by the procuring entity

(b) Software licences listed in the scope of supply shall all be supplied and installed into the servers even for those not detailed in this particular specification

(c) The operating systems/ virtual machines shall run SCADA applications for operation of critical power systems. Contractor shall when configuring the servers ensure the highest reliability of the systems configured for this purpose.

(d) Windows software installed into the production servers shall be configured with the optimal settings and services for an industrial control system use

(e) Virtual hardware resources i.e. CPU, RAM, storage etc shall be discussed with the employer and agreed upon after contract award. The resources shall be within the host server capability.

(f) Contractor shall train the procuring entity extensively on virtualisation, operating systems installation and configuration, Windows server services and applications configuration and all other items as detailed in this tender

(g) Contractor shall also offer commissioning support to the procuring entity during installation and commissioning of the cabinets by the procuring
Ten der for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

entity. Contractors personnel shall be physically onsite with the procuring entity personnel for this exercise

5.4.2.4.2 **Operations Production host servers**

Two (2) redundant production host servers shall be installed on the RCC server cabinet. Each production host server shall contain the following virtual machines:

(a) Windows 2016 server virtual machine with the following features
   (i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.
   (ii) VM may be downgraded to Windows 2012 R2 dependent on the SCADA application compatibility
   (iii) Fifty (50) user CALs
   (iv) Microsoft SQL server 2016 standard edition for 18 core servers (bidder to license all the cores in their offered server) with ten (10) user CALS each. Bidder to note that the licenses may be downgraded to MS SQL server 2012 dependent on the SCADA server application
   (v) Shall host the SCADA server application (to be supplied and installed by procuring entity)

(b) Windows 2016 server virtual machine with the following features
   (i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.
   (ii) VM may be downgraded to Windows 2012 R2 dependent on the SCADA application compatibility
   (iii) Fifty (50) user CALs
   (iv) Ten (10) RDS CALs
   (v) Shall host the SCADA client application (to be supplied and installed by procuring entity)

(c) Windows 2003 server virtual machine with the following features
   (i) Windows 2003 server standard edition, licences to be volume perpetual licence.
   (ii) Ten (10) user CALs
   (iii) VM shall be a virtualised existing physical server with an Oracle historian existing at site
Contractor shall virtualise the existing server porting all the existing functions and provide windows 2003 server licences (windows 2016 server or windows 2012 server etc may be downgraded to serve this purpose)

5.4.2.4.3 **DMZ Production host servers**

Two (2) redundant production host servers shall be installed on the RCC DMZ server cabinet. Each production host server shall contain the following virtual machines:

(a) Windows 2016 server virtual machine with the following features:
   (i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.
   (ii) VM may be downgraded to Windows 2012 R2 dependent on the SCADA application compatibility
   (iii) One hundred (100) user CALs
   (iv) Shall host the SCADA webserver application (to be supplied and installed by procuring entity)

(b) Windows 2016 server virtual machine with the following features
   (i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores all cores to be licensed.
   (ii) VM may be downgraded to Windows 2012 R2 dependent on the SCADA application compatibility
   (iii) Fifty (50) user CALs
   (iv) Ten (10) RDS CALs
   (v) Shall host the SCADA client application (to supplied and installed by procuring entity)

(c) Windows 2016 server virtual machine with the following features
   (i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.
   (ii) VM may be downgraded to Windows 2012 R2 dependent on the SCADA application compatibility
   (iii) Fifty (50) user CALs
   (iv) Microsoft SQL server 2016 standard edition for 18 core servers (bidder to license all the cores in their offered server) with ten (10)
user CALS each. Bidder to note that the licenses may be downgraded to MS SQL server 2012 dependent on the SCADA server application

(v) Shall host the SCADA historian application (to be supplied and installed by procuring entity)

(d) Windows 2003 server virtual machine with the following features

(i) Windows 2003 server standard edition, licences to be volume perpetual licence.

(ii) Ten (10) user CALs

(iii) VM shall be a virtualised existing physical server with an OSIsoft PI historian existing at site

(iv) Contractor shall virtualise the existing server porting all the existing functions and provide windows 2003 server licences (windows 2016 server or windows 2012 server etc may be downgraded to serve this purpose)

5.4.2.4.4 Operations Management host server

One (1) Management host server shall be installed on the RCC Operations server cabinet. It shall contain the following virtual machines:

(a) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) Fifty (50) user CALs

(iii) Shall host the vCenter server essentials plus application to be installed, tested and commissioned by the contractor for management of virtual machines on the operations cabinet.

(b) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) One hundred (100) user CALs

(iii) Shall host the Windows active directory services and optionally windows update server (WSUS). Domain controller application to be configured, tested and commissioned by the contractor for

- management of virtual machines users on the operations cabinet
- Authentication of users the SCADA operations side
• Other active directory services necessary for optimal running and management of the virtual environment

(c) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) Fifty (50) user CALs

(iii) Shall host any other assets management server applications either native to the windows server standard edition or to be installed by the procuring entity

5.4.2.4.5 **DMZ Management host server**

One (1) Management host server shall be installed on the RCC DMZ server cabinet. It shall contain the following virtual machines:

(a) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) Fifty (50) user CALs

(iii) Shall host the vCenter server essentials plus application to be installed, tested and commissioned by the contractor for management of virtual machines on the DMZ cabinet.

(b) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) One hundred (100) user CALs

(iii) Shall host the windows active directory services and windows update server (WSUS). Domain controller application to be configured, tested and commissioned by the contractor for

• management of virtual machines users on the DMZ cabinet
• Authentication of users the SCADA DMZ and corporate side
• Other active directory services necessary for optimal running and management of the virtual environment

(iv) Windows update server (WSUS shall be configured for carrying windows security updates on all the windows servers, workstations, thin client PC’s, rack mount Industrial PC and panel touch screen PC.
(c) Windows 2016 server virtual machine with the following features

(i) Windows 2016 server standard edition 18 core licences (16+2), licences to be volume perpetual licences. If bidder offers a host server with more than 18 cores, all cores to be licensed.

(ii) One hundred (100) user CALs

(iii) Shall host the network management system by solar winds (network performance monitoring database server and Kiwi syslog server

Network management system shall be installed, configured, tested and commissioned by the contractor for

- SNP traps of all networked devices in the scope of supply
- Syslog capture from all networked devices in the scope of supply
- Configure auto generation of network maps
- Other functions as specified

(iv) Microsoft SQL server 2016 standard edition for 18 core servers (bidder to license all the cores in their offered server) with ten (10) user CALS each. For the NMS applications.

(d) Hardened Operating system virtual machine for cyber security management server

(i) Shall host the cyber security management server with all the functionalities as detailed in tender

(ii) The operating system shall fully support VMware vSphere environment

(iii) Contractor shall install, configure and test the cyber security management server as detailed in the tender.

5.4.2.5 Network Attached Storage Server Specifications

5.4.2.5.1 General requirements

(a) A total of two network attached storage servers shall be supplied and installed in the server cabinets

(b) Servers shall be assembled into the cabinets by the bidder and shall be delivered to site in a completely assembled cabinet. All devices and components required to assemble the servers into the cabinet shall be
supplied by the bidder irrespective of whether they are stated in the schedules or not.

(c) Servers offered shall be complete with all hardware components, accessories, features and devices necessary for a complete functional rack mounted server computer irrespective of whether these features have been specified in these schedules or not.

(d) The servers supplied will be used as the data store for the virtual environment and for other data storage by employer.

(e) Each network attached storage servers shall contain an array of at least twelve 2TB 10K HDD in RAID 5 configuration. HDD to be grouped in three for RAID 5 configuration.

(f) NAS shall contain two SSD for operating system installation (in RAID 1 configuration).

(g) The offered servers shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
   (i) Temperature: 5 to 35°C (continuous)
   (ii) Altitude: ≥ 1000mASL
   (iii) Installation location: indoor with natural aeration only

5.4.2.5.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Intel® Xeon® scalable series</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(bidder to state exact model on offer)</em></td>
</tr>
<tr>
<td>2</td>
<td>No of processors &amp; sockets</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>3</td>
<td>No of cores on each processor</td>
<td>≥Ten (10)</td>
</tr>
<tr>
<td>4</td>
<td>No of threads on each processor</td>
<td>≥Twenty (20)</td>
</tr>
<tr>
<td>5</td>
<td>Processor Base Frequency</td>
<td>≥ 2.2GHz</td>
</tr>
<tr>
<td>6</td>
<td>L3 Cache</td>
<td>≥ 13.75MB</td>
</tr>
<tr>
<td>7</td>
<td>Ultra-Path Interconnect speed</td>
<td>≥ 2@10.4 GT/s</td>
</tr>
<tr>
<td>8</td>
<td>Processor TDP</td>
<td>≤100W</td>
</tr>
<tr>
<td>9</td>
<td>RAM type</td>
<td>DDR4 Registered (RDIMM) 2400MT/s</td>
</tr>
<tr>
<td>10</td>
<td>Number of RAM RDIMM slots</td>
<td>Twenty-four (24)</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Speed and type of installed RAM modules</td>
<td>RDIMM 2400MT/s</td>
</tr>
<tr>
<td>12</td>
<td>No of installed RAM modules</td>
<td>≥Two (2)</td>
</tr>
<tr>
<td>13</td>
<td>Size of each Installed RAM module</td>
<td>≥ 32GB</td>
</tr>
<tr>
<td>14</td>
<td>Total installed RAM</td>
<td>≥ 64GB</td>
</tr>
<tr>
<td>15</td>
<td>Storage drives bay:</td>
<td>16 SFF chassis on the front side, for hot swappable drives</td>
</tr>
<tr>
<td>16</td>
<td>RAID &amp; Storage controller</td>
<td>12GB/s SAS with mixed HDD &amp; SSD support (bidder to state exact controller model and type on offer)</td>
</tr>
<tr>
<td>17</td>
<td>Type of installed SSD drives (for operating system)</td>
<td>Hot plug SFF, SAS, 12G, 2.5-inch, mixed use SSD</td>
</tr>
<tr>
<td>18</td>
<td>Size of each installed SSD drives:</td>
<td>≥ 400GB</td>
</tr>
<tr>
<td>19</td>
<td>Number of installed SSD drives:</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>20</td>
<td>Total SSD storage size (for operating system)</td>
<td>≥ 800 GB</td>
</tr>
<tr>
<td>21</td>
<td>SSD cell type</td>
<td>SLC or eMLC</td>
</tr>
<tr>
<td>22</td>
<td>SSD minimum endurance rating</td>
<td>≥ 1 DWPD (writes per day)</td>
</tr>
<tr>
<td>23</td>
<td>Size of each installed RAID 5 HDD drives:</td>
<td>≥ 2 TB</td>
</tr>
<tr>
<td>24</td>
<td>Number of installed RAID 5 HDD drives:</td>
<td>≥ Twelve (12)</td>
</tr>
<tr>
<td>25</td>
<td>Total RAID 5 HDD storage size</td>
<td>≥ 24 TB</td>
</tr>
<tr>
<td>26</td>
<td>HDD Type and speed</td>
<td>10K RPM, SAS 12Gbps 512n, 2.5in Hot-plug SFF Hard Drive</td>
</tr>
<tr>
<td>27</td>
<td>Network controllers</td>
<td>One (1) dual port 10Gb Base-T and dual port 1Gb Base-T Ethernet controller (bidder to state exact controllers’ model and type on offer)</td>
</tr>
<tr>
<td>28</td>
<td>Total number 10Gb Base-T</td>
<td>≥Two (2)</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>29</td>
<td>Ethernet ports (RJ45)</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Total number 1Gb Base-T Ethernet ports (RJ45)</td>
<td>( \geq ) Two (2)</td>
</tr>
<tr>
<td>31</td>
<td>PCIE Expansion slots- PCIe X8, X16</td>
<td>( \geq ) Four (4)</td>
</tr>
<tr>
<td>32</td>
<td>USB ports</td>
<td>( \geq ) Two (2) rear ports &amp; ( \geq ) Two (2) front ports</td>
</tr>
<tr>
<td>33</td>
<td>USB 3.0 ports</td>
<td>( \geq ) Two (2)</td>
</tr>
</tbody>
</table>
| 34  | Video ports:                                                           | \( \geq \) one (1) DVI/DP rear port and \( \geq \) one (1) 1 VGA/HDMI/DP front port  
(The chosen ports MUST be supported by the KVM switch offered. Bidder to state the exact ports on offered server) |
| 35  | Power supply type                                                      | Hot plug, dual redundant power supply (1+1)                                                             |
| 36  | Number of hot plug Power supply units                                   | Two (2)                                                                                                 |
| 37  | Power rating of each power supply unit                                 | \( \geq \) 700W                                                                                         |
| 38  | Power input rating                                                     | 220-240V AC, 50Hz                                                                                      |
| 39  | Power supply Cord                                                      | C13 to C14, PDU Style                                                                                  |
| 40  | Mounting:                                                              | Rack type                                                                                               |
| 41  | Operating temperature without derating                                  | 0 to 35°C continuous                                                                                    |
| 42  | Mounting accessories                                                   | Rack rails and cable management arm to be provided                                                      |
| 43  | Manufacturer Warranty                                                  | 3 years parts, and 3 years basic support                                                               |

### 5.4.2.5.3 Product Certifications

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.
5.4.2.5.4 **External LTO Tape-Based Storage**

(a) An external Tape Backup LTO tape drives offering fast, reliable data backup and archive with a low total cost of ownership shall be supplied, installed and deployed to back up each NAS

(b) The drives shall be interfaced to each NAS server for regular NAS back up

(c) Each tape drives shall meet the following:

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>External Tape Backup type</td>
<td>LTO-8</td>
</tr>
<tr>
<td>2</td>
<td>Native Capacity</td>
<td>(\geq 12)TB</td>
</tr>
<tr>
<td>3</td>
<td>Native transfer rate per half-height drive (1080GB/hr)</td>
<td>(\geq 300)MB/s</td>
</tr>
<tr>
<td>4</td>
<td>native transfer rate per full-height drive (1296GB/hr)</td>
<td>(\geq 360)MB/s</td>
</tr>
<tr>
<td>5</td>
<td>Hardware encryption</td>
<td>Device-level AES-256</td>
</tr>
<tr>
<td>6</td>
<td>LTFS</td>
<td>Capable</td>
</tr>
<tr>
<td>7</td>
<td>SAS interface</td>
<td>(\geq 6)Gb/s</td>
</tr>
<tr>
<td>8</td>
<td>Compression</td>
<td>2.5:1</td>
</tr>
<tr>
<td>9</td>
<td>Serial Attached SCSI (SAS) Cable</td>
<td>6Gb Mini to HD-Mini SAS Cable, 5M</td>
</tr>
<tr>
<td>10</td>
<td>LTO Ultrium 8 Media Cartridge</td>
<td>(\geq 12)TB Native / (\geq 30)TB Compressed</td>
</tr>
<tr>
<td>11</td>
<td>LTO Tape Cleaners</td>
<td>(\geq 1) (1)</td>
</tr>
<tr>
<td>12</td>
<td>No of tapes (cartridges)</td>
<td>(\geq 5) (5)</td>
</tr>
<tr>
<td>13</td>
<td>Power input rating</td>
<td>220-240V AC, 50Hz</td>
</tr>
<tr>
<td>14</td>
<td>Power supply Cord</td>
<td>C13 to C14, PDU Style</td>
</tr>
<tr>
<td>15</td>
<td>Operating temperature without derating</td>
<td>0 to 35°C continuous</td>
</tr>
<tr>
<td>16</td>
<td>Manufacturer Warranty</td>
<td>(\geq 3) years</td>
</tr>
</tbody>
</table>

5.4.2.5.5 **Software and configuration**

(a) Each NAS server shall contain Microsoft Windows storage server 2016 standard edition with a minimum of the following:
Ten tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

(i) Windows 2016 storage server standard edition 16 core licences (standard), licences to be volume perpetual licences. If bidder offers a NAS server with more than 16 cores, all cores to be licensed.

(ii) Ten (10) user CALs

(iii) Shall host the data store for the DMZ virtual environment and data store for other functions.

(iv) Shall be supplied, installed and configured by the contractor

(b) Contractor shall configure each NAS to have four arrays of RAID 5 disks with each array having three 2TB 10K HDD

(c) Contractor shall configure the two NAS to be dual redundant with failover.

(i) The two NAS servers shall operate in a duty standby configuration.

(ii) Data in the two NAS shall be replicated automatically and failure of duty NAS server shall lead to automatic take over by the standby NAS. The transfer shall be seamless without data loss

(iii) On resumption from failure, the NAS shall transfer all the missing data from the duty NAS before becoming available in standby.

(iv) Only one NAS server shall be visible to client applications

(v) Contractor shall supply, install, configure and test all applications required for the NAS server redundancy and failover.

(vi) Redundancy and failover application shall also monitor disk failure and initiate failover if the number of disks failed exceed what is covered by RAID 5 configuration or if the failure will lead to loss of data.

(vii) Failed NAS server shall not be available in standby and alarm shall be generated to notify that NAS is no longer on standby.

(d) The NAS shall be configured to back up their data on the external tape drive. Scheduled data dumps shall also be scheduled in the a NAS applications. All features and applications required for data back up shall be provided and installed in the NAS.

5.4.2.6 Server cabinets

5.4.2.6.1 General requirements

(a) 42U Rack type free standing cabinet

(b) Colour shall be either be:
(i) RAL 7035 - light grey or
(ii) RAL 9005 fine texture - black or
(iii) Graphite Metallic equivalent

(c) Cabinet dimensions shall be within the limits below:
   (i) Height: 2000mm – 2300mm
   (ii) Width: 600mm – 800mm
   (iii) Depth: 950mm – 1200mm

(d) Cabinet Shall have:
   (i) Perforated sheet steel front door.
   (ii) Split (double), perforated sheet steel rear doors,
   (iii) multi-piece roof plate for side cable entry on both sides,
   (iv) Open base frame, without side panels.
   (v) Two 482.6 mm (19") vertical mounting rails, front and rear, on depth stay.
   (vi) Side panels, two-piece with quick-release fastener, security lock
   (vii) Accessories such as tool-free “snap-in technology” options for air flow, cable management, shelves, power distribution units and all other necessary and specified accessories
   (viii) All unutilised mounting racks shall be blanked from the front with easily removable blanking plates.

(e) The following devices shall be provided and installed on the panel
   (i) Two (2) sets of keys (front and rear)
   (ii) Top mounted roof exhaust cooling fans
   (iii) Roof exhaust cooling Air throughput ≥750m³/h
   (iv) Roof exhaust cooling fan mounting size ≥290mmX290mm

(f) All panel mounted equipment shall be labelled using Aluminium anodized plate or engraved plastic Castings as detailed in clause 5.3.6.5 and 5.3.2.7

5.4.2.6.2 Frames

(a) Frame shall be made of sheet steel metal plate of at least 1.5 mm in thickness

(b) Shall consist of Pre-configured rack consisting of Torsional stiff, welded symmetrical frame of rolled 16-fold vertical members connected with two horizontal frames of rolled 9-fold members with integral channel for accommodating the adjacent panel seal and protecting it against possible effect of aggressive media.

(c) All frame members, with integral system holes on a 25 mm DIN pitch pattern, allow convenient interior installation by simple fitting and
securing of equipment. All sections have chamfered edges. The vertical frame members each have two depth-recessed horizontal mounting rails that can be used for flexible attachment of installation components.

(d) Enclosures are bay-able on all sides: on the left, right, front and rear and at the top or round corners.

(e) Baying of cabinets shall be accomplished without disturbing any installed cables or rack mounted equipment.

(f) Baying of cabinets shall be easily accomplished with simple tools.

(g) Baying cabinets will not add any additional overall width to a contiguous row.

5.4.2.6.3 **Front Door**

(a) Sheet steel front door with a specific honeycomb perforation, vented surface area, 85% perforated.

(b) Four-point locking rod, comfort handle for semi-cylinder, with security lock.

(c) Four hinges, with captive hinge pins, hinge opening angle with stand-alone sitting 180°, door hinge may be swapped to opposite side without dismantling locking rods.

5.4.2.6.4 **Rear Door**

(a) Sheet steel rear doors, vented, vertically divided, for space-saving installation of the enclosures and easy access to the components.

(b) Specific honeycomb perforation, vented surface area, 85% perforated. Doors with foamed-in seal.

(c) Main door with four-point locking rod, comfort handle for semi cylinder, with security lock.

(d) Adjacent door with additional internal swing lever handle and two-point locking rod.

(e) Main and adjacent door with four hinges, hinges with captive hinge pins, hinge opening angle with stand-alone sitting on both sides 180°.

5.4.2.6.5 **Roof**

(a) Multi-piece roof plate for side cable entry via brush strips across the entire enclosure depth. Roof plate for retrofitting, removable despite already made cable routing.

(b) Cable entry outside the mounting rails is possible.

(c) Cut-out for accommodating a fan module integrated in the roof.
(d) Panel cooling fan to be mounted with ratings as specified in the proceeding clauses.

5.4.2.6.6 Base plate

(a) Open base frame, gland plates, and other accessories for cable termination to be provided.

5.4.2.6.7 Mounting Rails

(a) With two 482.6 mm (19”) vertical mounting rails, front and rear. The static total load capacity of both mounting rails shall be at least 15,000 N.

(b) Universal mounting rails shall support installation of industry standard 19” rack mount server, network and electronic components, infinitely depth variable attached to depth stays.

(c) The attachment of the mounting rails shall be flexible and tool-less using quick release fasteners or screw-fasteners as an alternative.

(d) Mounting rails, front and rear, including additional pitch pattern of holes according to standard EIA 310 E.

(e) All height units shall be labelled and numbered in the opposite direction. U labelling of both mounting rails shall be readable from the front for easy one-man assembly.

(f) Each U space shall be marked on the middle hole of each U. Each U shall consist of three holes and measure 1.75” or 44.45 mm high. Each U space marking shall be printed, not adhesive backed.

(g) All depth stays with integral pitch pattern for fast determination of the mounting distance and the remaining front free space (clearance).

(h) 19” mounting rails shall have two additional sets of mounting holes, shall match hole pattern of the frame and allow for the installation of various accessories, i.e. vertical cable management, horizontal cable management, power strips, etc.

(i) Front mounting rails, prepared for tool-less accommodation of cable routing aids and organization of a structured cabling in maximum packaging density or for equipment with a sensor strip for automatic identification of the installed components by means of Radio Frequency Identification (RFID).

(j) Rear mounting rails prepared for two-sided accommodation of a Power Distribution Unit (PDU) in 1 U form factor for enclosure electrification, without waste of installation volume thanks to space-saving side mounting between mounting rail and side panel in the Zero-U space.
(k) Enclosures widths equal to or greater than 28”/700 mm allow for 19”, 21”, and 23” rack mounting of components and/or allow for the offsetting of 19” rails, left or right, to allow for additional cable management and air plenum space.

5.4.2.6.8 **Grounding**

(a) All enclosure components such as doors, sidewalls, roof, etc. Shall be bonded directly to the frame Grounding points.

(b) A copper busbar shall be mounted on the cubicle for grounding the electrical equipment.

(c) Conductors of 4 mm² diameter and a central ground point for connection to the building service connection shall be provided

(d) The mounting rails shall be connected to the frame by 4 mm conductors.

(e) Cabinet shall comply with IEC 60950 safety standard applicable to mains-powered or battery-powered information technology equipment.

5.4.2.6.9 **Cable management**

(a) All cables (patch cords, power cords etc.) shall be guided neatly in the cabinet.

(b) Horizontal & vertical cable managers shall be supplied and installed for guiding all cables in the cabinet.

(c) Cable managers shall be made of halogen free & flame-retardant materials.

(d) Cable ties shall not be used to support cables to frames or to mounting rails. When used, cable ties shall only be used to guide and arrange cables in the cable managers.

(e) All cables shall be labelled clearly with an indelible printed/engraved PVC label.

5.4.2.7 **Work stations Specifications**

5.4.2.7.1 **General requirements**

(a) Bidder shall supply two complete rack mounted workstation computers mounted into each server cabinets. Each cabinet shall have one workstation mounted.

(b) Workstation computers shall be assembled into the cabinets by the bidder and shall be delivered to site in a completely assembled cabinet. All devices and components required to assemble the workstations into the cabinet
shall be supplied by the bidder irrespective of whether they are stated in the schedules or not.

(c) Workstation computers offered shall be complete with all hardware, accessories, feature, components and devices necessary for a complete functional rack mounted workstation computer irrespective of whether these features have been specified in these schedules or not.

(d) The workstations supplied will management workstations and shall run applications necessary for management of the virtual environment and any other client application for configuring/managing the server applications installed on the servers. They shall provide GUI to the virtual machines via remote login.

(e) The offered workstations shall be enterprise grade designed for 24/7 operation at the following environmental conditions:

(i) Temperature: 5 to 35°C (continuous)

(ii) Altitude: ≥ 1000mASL

(iii) Installation location: indoor with natural aeration only

5.4.2.7.2 Minimum specifications

Workstations shall meet a minimum of the following specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Intel® Core™ i7- eighth or ninth generation series or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intel® Xeon® silver series or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intel® Xeon® Gold series or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intel® Xeon® Platinum series</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(bidder to state exact model on offer)</em></td>
</tr>
<tr>
<td>2</td>
<td>No of processors &amp; sockets</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>3</td>
<td>No of cores on each processor</td>
<td>≥Four (4)</td>
</tr>
<tr>
<td>4</td>
<td>No of threads on each processor</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>5</td>
<td>Processor Base Frequency</td>
<td>≥ 2.6GHz</td>
</tr>
<tr>
<td>6</td>
<td>L3 Cache</td>
<td>≥ 8MB</td>
</tr>
<tr>
<td>7</td>
<td>Processor TDP</td>
<td>≤100W</td>
</tr>
<tr>
<td>8</td>
<td>Workstation Operating system</td>
<td>Licensed, pre-installed Windows 10 pro 64-bit for workstations. OEM licensed for all the processors/cores offered.</td>
</tr>
</tbody>
</table>

## Technical Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>RAM type</td>
<td>DDR4 Registered (RDIMM) 2400MHz</td>
</tr>
<tr>
<td>10</td>
<td>Number of RAM RDIMM slots</td>
<td>≥Four (4)</td>
</tr>
<tr>
<td>11</td>
<td>Speed and type of installed RAM modules</td>
<td>DDR4 RDIMM 2400MHz</td>
</tr>
<tr>
<td>12</td>
<td>No of installed RAM modules</td>
<td>≥Two (2)</td>
</tr>
<tr>
<td>13</td>
<td>Size of each Installed RAM module</td>
<td>≥ 8GB</td>
</tr>
</tbody>
</table>
| 14  | RAID & Storage controller                    | 6GB/s, four port (4) or higher SATA RAID controller with mixed HDD & SSD support  

*(bidder to state exact controller model and type on offer)*

| 15  | Type of installed drives                     | ≥6G, 2.5-inch, SSD drives                                                   |
| 16  | Size of each installed SSD drives:           | ≥ 512GB                                                                     |
| 17  | Number of installed SSD drives:              | ≥ One (1)                                                                   |
| 18  | Internal optical drive                       | One (1) DVD+-/RW drive                                                     |
| 19  | Graphics card                                | Dual, NVIDIA® Quadro® P series or higher GPU.  

*(bidder to state exact NVIDIA Quadro GPU model and type on offer)*

| 20  | Number of graphics cards                     | ≥ One (1)                                                                   |
| 21  | GPU Memory size                              | ≥2048 MiB                                                                  |
| 22  | GPU clock                                    | ≥1100 MHz                                                                  |
| 23  | Video ports:                                 | ≥ Two (2) VGA/DVI/DP/HDMI ports.  

*With at least a DVI/DP port  
*(The chosen ports MUST be supported by the KVM switch offered. Bidder to state the exact ports on offered workstation)*

| 24  | Maximum video resolution supported           | ≥2560 x 1600                                                                |
| 25  | Supported Display outputs                    | ≥ Two (2)                                                                   

*(Minimum of dual display output)*

| 26  | Network controller                           | Embedded 1Gb (or higher), base-T four port ethernet port controller.       |
## Technical Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(bidder to state exact controller model and type on offer)</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Gigabit Ethernet ports (RJ45)</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>28</td>
<td>PCIE Expansion slots- PCIe X8, X16</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>29</td>
<td>USB ports</td>
<td>≥ Two (2) rear ports &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ Two (2) front ports</td>
</tr>
<tr>
<td>30</td>
<td>USB 3.0 ports</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>31</td>
<td>Audio</td>
<td>Integrated audio with standard 3.5mm line in and line out ports</td>
</tr>
<tr>
<td>32</td>
<td>Number of Power supply units</td>
<td>≥ One (1)</td>
</tr>
<tr>
<td>33</td>
<td>Power rating of each power supply unit</td>
<td>≥ 800W</td>
</tr>
<tr>
<td>34</td>
<td>Power input rating</td>
<td>220–240V AC, 50Hz</td>
</tr>
<tr>
<td>35</td>
<td>Power supply Cord</td>
<td>C13 to C14, PDU Style</td>
</tr>
<tr>
<td>36</td>
<td>Mounting:</td>
<td>Rack type</td>
</tr>
<tr>
<td>37</td>
<td>Form factor (fully configured):</td>
<td>1U/2U/3U/4U</td>
</tr>
<tr>
<td>38</td>
<td>Mounting accessories</td>
<td>Rack rails and cable management arm to be provided</td>
</tr>
<tr>
<td>39</td>
<td>Operating temperature without derating</td>
<td>0 to 35°C continuous</td>
</tr>
<tr>
<td>40</td>
<td>Manufacturer Warranty</td>
<td>3 years parts, and 3 years basic support</td>
</tr>
<tr>
<td>41</td>
<td>Preinstalled Software applications</td>
<td>Virtualisation management client vSphere client, web browser all other client applications necessary for administration/management of equipment supplied as detailed elsewhere in the tender</td>
</tr>
</tbody>
</table>

### 5.4.2.7.3 Product Certifications

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided.

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.
5.4.2.8 **CISCO Ethernet Switches**

Four (4) Cisco C3850-24XU-S or equivalent ethernet switches meeting the following requirements shall be supplied, installed into the cabinet, configured and tested by the contractor.

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model &amp; Type</td>
<td>Cisco Catalyst 3850-24XU-S or an equivalent made by Cisco</td>
</tr>
<tr>
<td>2</td>
<td>Device Type</td>
<td>Switch - 24 ports - L3 - managed - stackable</td>
</tr>
<tr>
<td>3</td>
<td>Subtype</td>
<td>Gigabit Ethernet</td>
</tr>
<tr>
<td>4</td>
<td>Downlink Ports</td>
<td>24 x 10/100/1000 (UPOE)</td>
</tr>
<tr>
<td>5</td>
<td>Uplink ports</td>
<td>2 x 1000 base x fiber optic</td>
</tr>
<tr>
<td>6</td>
<td>Type of Downlink ports</td>
<td>Gigabit base –T, RJ45</td>
</tr>
<tr>
<td>7</td>
<td>Type of Uplink ports</td>
<td>SFP 1000BASE-X</td>
</tr>
<tr>
<td>8</td>
<td>SFP modules</td>
<td>Two (2) with LC connectors</td>
</tr>
<tr>
<td>9</td>
<td>Form factor:</td>
<td>1 rack unit (RU)</td>
</tr>
<tr>
<td>10</td>
<td>Power Over Ethernet</td>
<td>UPOE</td>
</tr>
<tr>
<td>11</td>
<td>PoE Budget</td>
<td>580W</td>
</tr>
<tr>
<td>12</td>
<td>Switching capacity:</td>
<td>92Gbps</td>
</tr>
<tr>
<td>13</td>
<td>Stacking bandwidth:</td>
<td>480 Gbps</td>
</tr>
<tr>
<td>14</td>
<td>Forwarding performance (64-byte packet size):</td>
<td>460 Mbps</td>
</tr>
<tr>
<td>15</td>
<td>IPv4 routes Capacity</td>
<td>24000</td>
</tr>
<tr>
<td>16</td>
<td>Net Flow entries capacity:</td>
<td>24000</td>
</tr>
<tr>
<td>17</td>
<td>Switched virtual interfaces (SVIs) capacity</td>
<td>1000</td>
</tr>
<tr>
<td>18</td>
<td>Virtual interfaces (VLANs) capacity</td>
<td>4000</td>
</tr>
<tr>
<td>19</td>
<td>Jumbo frame Support</td>
<td>9198 bytes</td>
</tr>
<tr>
<td>20</td>
<td>Authentication Method</td>
<td>Kerberos, RADIUS, Secure Shell (SSH), TACACS+</td>
</tr>
<tr>
<td>21</td>
<td>RAM</td>
<td>4GB</td>
</tr>
<tr>
<td>22</td>
<td>Flash Memory</td>
<td>2 GB</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>MAC Address Table Size</td>
<td>32000 entries</td>
</tr>
<tr>
<td>24</td>
<td>Form Factor</td>
<td>Rack-mount 1U</td>
</tr>
<tr>
<td>25</td>
<td>Stackable</td>
<td>stackable</td>
</tr>
<tr>
<td>26</td>
<td>Advanced Switching</td>
<td>Layer 3</td>
</tr>
<tr>
<td>27</td>
<td>Features and protocols that shall be supported</td>
<td>802.1x authentication, ARP inspection, Dynamic Trunking Protocol (DTP) support, Energy Efficient Ethernet, Link Aggregation Control Protocol (LACP), Multiple Spanning Tree Protocol (MSTP) support, PIM snooping, Port Aggregation Protocol (PAgP) support, Quality of Service (QoS), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Remote Switch Port Analyzer (RSPAN), SSH support, ARP support, Shaped Round Robin (SRR), Syslog support, Trivial File Transfer Protocol (TFTP) support, Uni-Directional Link Detection (UDLD), VLAN Trunking Protocol (VTP), Virtual Route Forwarding-Lite (VRF-Lite), Virtual Routing and Forwarding (VRF), Weighted Tail Drop (WTD), radio resource management (RRM), Access Control List (ACL) support, Bridge protocol data unit (BPU), Cisco Stack Power technology, Cisco StackWise-480 technology, Control plane protection (CoPP), DHCP snooping, DHCP support (bidder to state compliance to these requirements and indicate any deviation)</td>
</tr>
<tr>
<td>28</td>
<td>Manageable</td>
<td>Yes</td>
</tr>
<tr>
<td>29</td>
<td>Routing Protocol</td>
<td>EIGRP, RIP-1, RIP-2, RIPng</td>
</tr>
<tr>
<td>30</td>
<td>Remote Management Protocol</td>
<td>CLI, RMON 1, RMON 2, SNMP 1, SNMP 2c, SNMP 3, SSH, TFTP, Telnet</td>
</tr>
<tr>
<td>31</td>
<td>Power supply configuration</td>
<td>Dual redundant power supply (1+1)</td>
</tr>
<tr>
<td>32</td>
<td>Number of Installed Power supply units</td>
<td>Two (2)</td>
</tr>
<tr>
<td>33</td>
<td>Power supply voltage and type</td>
<td>220-240V AC, 50Hz</td>
</tr>
<tr>
<td>34</td>
<td>Power supply units</td>
<td>1100W AC</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Power supply Cord</td>
<td>C13 to C14, PDU style</td>
</tr>
<tr>
<td>36</td>
<td>Compliant Standards</td>
<td>CISPR 22 Class A, CISPR 24, EN 61000-3-2, NOM, EN 61000-3-3, EN55024, EN50082-1, EN 61000-6-1, EN 61000-4-4, EN 61000-4-2, EN 61000-4-3, EN 61000-4-6, CCC, ICES-003 Class A, EN 61000-4-5, FCC CFR47 Part 15, UL 60950-1, IEC 60950-1, EN 60950-1, UL 60950-1 Second Edition, KCC, RoHS, FCC Part 15 A, AS/NZS 3548 Class A, BSMI Class A, CAN/CSA C22.2 No. 60950-1, EN 60950-1 Second Edition, IEC 60950-1 Second Edition, VCCI Class A, KN24, KN22 Class A, EN 300386, AS/NZS CISPR 22, CNS 13438, EN 55022 Class A</td>
</tr>
<tr>
<td>37</td>
<td>Software Type</td>
<td>Cisco IOS IP Base</td>
</tr>
<tr>
<td>38</td>
<td>Mounting accessories</td>
<td>Rack slide rails to be provided</td>
</tr>
</tbody>
</table>
| 39  | Manufacturer warranty terms & Pre-installed Licences | • SMARTnet licence  
• 3-year hardware warranty-replacement & SLA  
• Cisco software access  
• Cisco 24/7 online support |

5.4.2.9 **KVM Console with Switch**

### 5.4.2.9.1 General requirements

(a) Shall consist of an Integrated KVM console with:
   (i) integrated retractable 19” LED-backlit LCD monitor
   (ii) 8-port KVM switch for connecting to eight computer hosts.
   (iii) Illuminated keyboard and touch pad
   (iv) Dual Rail housing

(b) Physically the console shall consist of four main parts: Keyboard module, LCD monitor, rear KVM switch and Rack mounting devices/accessories.

(c) The Dual Rail system shall separate the LCD module from keyboard/touchpad module so that they can move independently of each
other. This shall allow the keyboard/touchpad to be pushed back into the housing and out of the way when not in use, while the LCD screen can be rotated up to the rack for convenient monitoring of server operation – the LCD module’s range of rotation shall be adjustable to provide the best viewing angle.

(d) Console shall support remote KVM over IP access through Ethernet. It shall have an ethernet port.

(e) KVM switch shall support multi user access via IP and locally via a secondary console.

(f) Console shall be connected to the servers and workstations via KVM adapter cables designed to connect to the host computer USB and video port.

(g) KVM cable shall consist of space-saving RJ-45 connectors on the console side and Cat 5e/6 cabling. Video connector and USB plug shall be connected to the cat5e/6 cable at the host PC side.

(h) The Console shall a secondary console port to allow access of computers connected to the LCD KVM switch from an external console.

(i) Console keyboard module shall consist of the standard 105 key keyboard, touch pad, KVM port selection buttons & LED’s, power and other status indication LED’s and a front facing USB port Supporting an external USB mouse.

(j) Dual Rail mounting shall allow LCD monitor to slide independently of the keyboard/touchpad.

(k) LCD module shall rotate up to 120 degrees and tilt for a more comfortable viewing angle.

(l) Keyboard shall have LED illumination light to illuminate the keyboard and touchpad to allow visibility in lowlight conditions.

(m) Console shall have a port for firmware updates.

(n) Servers and workstations in each cabinet shall be connected to the console.

(o) Console shall allow easy computer selection via pushbuttons, Hotkey Mode, OSD (On-screen Display), or Browser-based GUI.

(p) Shall support multiple browsers: Internet Explorer, Chrome, Firefox, Safari, Opera, Mozilla, Netscape etc.

(q) The KVM console mounting panels, brackets, levers and Switch casing/enclosure shall be made of steel.
(r) Accessories, features and devices usual and necessary for a server cabinet rack mounted KVM console and switch shall be supplied and installed by the contractor irrespective of whether they have been specified or not.

(s) Contractor shall connect the servers and the workstation computer on each cabinet to the KVM console. Accessories and devices required to do all the connections shall be supplied.

(t) The offered KVM console shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
   (i) Temperature: 5 to 35°C (continuous)
   (ii) Altitude: ≥ 1000mASL
   (iii) Installation location: indoor with natural aeration only

5.4.2.9.2 Minimum specifications

KVM console shall meet the following minimum specifications

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Secondary Console Ports</td>
<td>≥Two (2) USB, ≥One (1) video (DVI/VGA/DP/HDMI)</td>
</tr>
<tr>
<td>2</td>
<td>External USB Mouse Ports</td>
<td>≥one (1)</td>
</tr>
<tr>
<td>3</td>
<td>Number of KVM Ports (RJ-45 Male)</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>4</td>
<td>LAN Ethernet Ports (RJ45)</td>
<td>≥one (1)</td>
</tr>
<tr>
<td>5</td>
<td>Port selection Push buttons</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>6</td>
<td>Port online status LEDs</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>7</td>
<td>Port selected status LEDs</td>
<td>≥Eight (8)</td>
</tr>
<tr>
<td>8</td>
<td>Ethernet status LED</td>
<td>Two (2)</td>
</tr>
<tr>
<td>9</td>
<td>Console power status LED</td>
<td>one (1)</td>
</tr>
<tr>
<td>10</td>
<td>LCD power status LED</td>
<td>one (1)</td>
</tr>
<tr>
<td>11</td>
<td>KVM cable console connector</td>
<td>one (1) RJ45 male</td>
</tr>
<tr>
<td>12</td>
<td>KVM cable type</td>
<td>Cat5e/6/7</td>
</tr>
<tr>
<td>13</td>
<td>KVM cable length</td>
<td>≥2m</td>
</tr>
<tr>
<td>14</td>
<td>KVM host adapter cable connectors</td>
<td>- Two (2) USB and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- One (1) video (DVI/DP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Video connector to be compatible</td>
</tr>
</tbody>
</table>
### Technical Specifications

#### 5.4.2.9.3 Product Certifications

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

#### 5.4.2.10 Server Cabinet Networking Accessories

5.4.2.10.1 A minimum of the following networking equipment and accessories shall be supplied and installed into each server cabinet

(a) Six (6) twisted pair Cat 7, 24 port shielded patch panels meeting requirements of clause 5.3.8.1
(b) One (1) twenty-four port Fibre optic panel meeting requirements of clause 5.3.8.2 with twenty-four LC port modules

(c) One hundred and twenty (120) cat 7 twisted pair ethernet patch chords meeting requirements of clause 5.3.8.3 for device to patch panel connections. The patch chords shall either be RJ45 to RJ45 or RJ45 to TERA™

(d) Sixty (60) cat 7 RJ45 to RJ45 twisted pair ethernet patch chords meeting requirements of clause 5.3.8.3 for patch panel to patch panel connections.

(e) Two (2) Single mode duplex LC-LC connector Fibre optic patch cords meeting requirements of clause 5.3.8.4 for cascading the two ethernet switches in each cabinet

(f) Twelve (12) rack mount cable entry panels for guiding the networking cables.

5.4.2.10.2 All devices and components required to network (local area network) all the major components in each cubicle as listed in clause 5.2.3.1 shall be supplied by the bidder irrespective of whether they are stated in the specifications or not.

5.4.2.11 Server Cabinet Electrical Accessories

5.4.2.11.1 General Requirements

(a) A minimum of the electrical accessories detailed in clause 5.2.3.10 shall be supplied and installed into each server cabinet

(b) Panel power supplies shall be designed and installed as per requirements of clause 5.3.3

(c) Miniature circuit breakers, shall meet requirements of clause 5.3.3.3

(d) Panel electrical wiring shall be carried out as detailed in clause 5.3.6.2

(e) Terminal blocks shall meet requirements of clause 5.3.6.4

5.4.2.11.2 Power distribution Units (PDU)

(a) General requirements

(i) Two 16 outlet PDU’s shall be installed in each of the two cabinets to be supplied.

(ii) PDU’s shall be rack mounted with a steel enclosure and mounting.

(iii) PDU enclosure shall have cord retention brackets for securing power outlet cords.
(iv) Each PDU shall be rated for a continuous current rating of 32A @ 40°C ambient temperature.

(v) It shall have an internal manual reset circuit breaker for overload and short circuit protection. Trip resetting shall be possible from the rear.

(vi) The PDU shall have power input cord hardwired to a double pole AC MCB.

(vii) PDU shall have a sensor to measure the current used by the PDU and each of its attached devices.

(viii) The PDU shall be accessible remotely via an ethernet, it shall support Web (HTTPS), Telnet, SNMP, SSH etc. access.

(ix) PDU shall have at least three LEDs for General warnings, overload warning and power input status.

(x) All the cabinet IT equipment power supply inputs shall be connected to the PDU’s by the contractor. For devices with redundant power supply units each power supply unit input shall be connected to a different PDU.

(xi) PDU’s shall be supplied and installed complete with all the usual & necessary accessories, feature and devices required for power supply of server cabinet mounted IT equipment.

(xii) Power cords supplied shall be enterprise grade rated for continuous operation at rated current at 40°C temperature. The cords conductor shall be stranded high grade electrolytic copper conductors at least 1.0mm² thick.

(xiii) Power cords shall be clearly labelled with Printed indelible PVC labels.

(xiv) The PDU shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
- Temperature: 0 to 50°C (continuous)
- Altitude: ≥ 1000mASL
- Installation location: indoor with natural aeration only

### 5.4.2.11.3 Minimum Specifications

PDU shall meet the following minimum specifications

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type of PDU output connectors</td>
<td>IEC 60320/C13 (female)</td>
</tr>
<tr>
<td>No</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>----</td>
<td>---------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Number Output connectors</td>
<td>≥Sixteen (16)</td>
</tr>
<tr>
<td>3</td>
<td>Nominal Voltage Rating</td>
<td>220–240V AC</td>
</tr>
<tr>
<td>4</td>
<td>Input Voltage range</td>
<td>210–250V AC</td>
</tr>
<tr>
<td>5</td>
<td>Input Frequency range</td>
<td>45–60Hz</td>
</tr>
<tr>
<td>6</td>
<td>PDU continuous input current rating</td>
<td>@ 40°C ambient temperature, ≥32A</td>
</tr>
<tr>
<td>7</td>
<td>Overload protection</td>
<td>32A</td>
</tr>
<tr>
<td>8</td>
<td>Maximum outlet current rating</td>
<td>≥12A</td>
</tr>
<tr>
<td>9</td>
<td>Nominal power supply rating</td>
<td>≥7400W</td>
</tr>
<tr>
<td>10</td>
<td>Mounting type</td>
<td>1U/2U rack</td>
</tr>
<tr>
<td>11</td>
<td>Power outlet cord connector type</td>
<td>C13 to C14</td>
</tr>
<tr>
<td>12</td>
<td>Power outlet cords continuous current rating</td>
<td>@ 40°C ambient temperature, ≥10A</td>
</tr>
<tr>
<td>13</td>
<td>Number of power cords to be supplied per PDU</td>
<td>≥sixteen (16) (un utilised cables to be provided as spares)</td>
</tr>
<tr>
<td>14</td>
<td>PDU Operating temperature</td>
<td>0 to 50°C continuous</td>
</tr>
<tr>
<td>15</td>
<td>PDU Enclosure &amp; support brackets</td>
<td>Robust steel construction.</td>
</tr>
</tbody>
</table>

(a) Product Certifications
   (i) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided
   (ii) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

5.4.2.11.4 Socket Strips

(a) They shall meet requirements of clause 5.3.3.6
(b) A socket strip composed of at least four British type (IEC Type G) sockets shall be rack mounted on the front side of each panel.
(c) The socket strip shall have an illuminated switch facing the front side of panel
(d) Double socket Euro type (CEE 7/3) DIN mount socket strip shall be mounted on the rear of each cabinet.
(e) Double socket British type (IEC type G) DIN rail mount socket strip shall be mounted on the rear of each cabinet
(f) Socket Strips power supply input shall be hardwired directly to wiring terminal blocks.

5.4.2.11.5 Panel cooling Ventilation fans

(a) Dual redundant ventilation fans to be installed on the panel roof for exhausting excess heat from the cabinet
(b) Shall be a roof exhaust unit for mounting on the top of the enclosure providing natural ventilation.
(c) Shall be made of Painted mild steel, and injection-moulded thermoplastic (ABS-FR) self-extinguishing,
(d) Temperature resistance: -15°C to +55°C.
(e) Air flow of at least 750 m³/h
(f) Power supply rating 240V AC, 50Hz
(g) To be hardwired to the MCB
(h) Suitably rated MCB (below 3A) to be installed for fan protection

5.4.3 SCADA OPERATOR WORKSTATIONS EQUIPMENT

5.4.3.1 Thin Client PC

5.4.3.1.1 General requirements

(a) Thin client PC shall be fan-less light duty 64-bit PC to be used primarily for remote access of virtual machines in the servers and industrial PC’s via RDP
(b) Thin PC’s offered shall be complete with all hardware components, accessories, features and devices necessary for a complete thin client PC dedicated to virtual machines access irrespective of whether these features have been specified in these schedules or not.
(c) The thin clients supplied will be used by procuring entity to interface operators to the SCADA client application. They shall be the primary interface to all SCADA operations by the operator. All features necessary for reliable and robust operator workstation for industrial control shall be provided
(d) The offered thin client PC shall be enterprise grade designed for 24/7 operation at the following environmental conditions:
(i) Temperature: 5 to 35°C (continuous)  
(ii) Altitude: ≥ 1000mASL  
(iii) Installation location: indoor with natural aeration only

5.4.3.1.2 Minimum specifications

Thin client PC’s shall meet a minimum of the following specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Quad core processor</td>
</tr>
<tr>
<td>2</td>
<td>Processor Base Frequency</td>
<td>≥ 2.0GHz</td>
</tr>
<tr>
<td>3</td>
<td>Processor Cache</td>
<td>≥ 2MB</td>
</tr>
<tr>
<td>4</td>
<td>Processor TDP</td>
<td>≤20W</td>
</tr>
<tr>
<td>5</td>
<td>Operating system</td>
<td>OEM Windows 10 IoT Enterprise LTSB</td>
</tr>
<tr>
<td>6</td>
<td>RAM type</td>
<td>DDR4, ≥1,866 MT/s</td>
</tr>
<tr>
<td>7</td>
<td>Size of Installed RAM</td>
<td>≥ 8GB</td>
</tr>
<tr>
<td>8</td>
<td>Type of secondary storage</td>
<td>MLC, NAND flash memory</td>
</tr>
<tr>
<td>9</td>
<td>Size of secondary storage</td>
<td>≥ 64GB</td>
</tr>
<tr>
<td>10</td>
<td>Flash memory Endurance</td>
<td>≥100 TBW (Terabytes written)</td>
</tr>
<tr>
<td>11</td>
<td>Graphics Memory size</td>
<td>≥1024 MiB (separate or in RAM)</td>
</tr>
<tr>
<td>12</td>
<td>GPU clock</td>
<td>≥600MHz</td>
</tr>
<tr>
<td>13</td>
<td>Video ports:</td>
<td>≥ Two (2) DVI/DP/HDMI ports.</td>
</tr>
<tr>
<td>14</td>
<td>Maximum video resolution</td>
<td>≥3840 x 2160 @ 60 Hz</td>
</tr>
<tr>
<td>15</td>
<td>supported on each video port</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Supported Display outputs</td>
<td>≥ Two (2) @ 3840 x 2160 resolution</td>
</tr>
<tr>
<td></td>
<td>(Minimum of dual display output)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Gigabit Ethernet ports (RJ45)</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>18</td>
<td>USB ports</td>
<td>≥ Two (2) rear ports &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ Four (4) front ports</td>
</tr>
<tr>
<td>19</td>
<td>Audio</td>
<td>Internal amplified speaker system</td>
</tr>
<tr>
<td>20</td>
<td>Audio ports</td>
<td>standard 3.5mm line in and line out ports</td>
</tr>
<tr>
<td>21</td>
<td>Type of Power supply units</td>
<td>External</td>
</tr>
<tr>
<td>26</td>
<td>Power rating of power supply</td>
<td>≥ 65W</td>
</tr>
<tr>
<td></td>
<td>unit</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>27</td>
<td>Power input rating</td>
<td>220-240V AC, 50Hz</td>
</tr>
<tr>
<td>28</td>
<td>Power supply Cord</td>
<td>C13/C14 to BS1363 (IEC type G-British type) plug</td>
</tr>
<tr>
<td>29</td>
<td>Mounting</td>
<td>Desktop or panel mount</td>
</tr>
<tr>
<td>36</td>
<td>Device Cooling</td>
<td>Natural, heat sink or solid state fan less</td>
</tr>
<tr>
<td>37</td>
<td>Continuous operating ambient</td>
<td>10° C to +35°C</td>
</tr>
<tr>
<td></td>
<td>temperature</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Operating Relative Humidity (non-</td>
<td>10 to 85%</td>
</tr>
<tr>
<td></td>
<td>condensing)</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Operating altitude without</td>
<td>≥1000 m</td>
</tr>
<tr>
<td></td>
<td>derating</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Supported remote desktop</td>
<td>(i) Microsoft: Remote FX (RFX), RDP</td>
</tr>
<tr>
<td></td>
<td>protocols</td>
<td>(ii) VMware®: RDP, PCoIP</td>
</tr>
<tr>
<td>31</td>
<td>Preinstalled Software applications</td>
<td>(i) Microsoft Remote Desktop Client</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) VMware™ Horizon View™ Client</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Microsoft firewall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iv) Windows defender</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(v) Internet Explorer</td>
</tr>
<tr>
<td>32</td>
<td>Manufacturer Warranty</td>
<td>≥3 years</td>
</tr>
</tbody>
</table>

5.4.3.1.3 **Product Certifications**

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

5.4.3.2 **27.0 Inch LED backlit LCD monitor**

5.4.3.2.1 **General Requirements**

(a) Shall be connected to the thin client PC’s via the KVM switch

(b) Two displays shall be placed at the operator desks (by the procuring entity)

(c) At minimum each LCD monitors shall have three Video inputs an audio output and an audio input

(d) The monitors shall be LED backlight LCD type or OLED type

(e) Shall have ergonomic design for long period usage without eye strain
(f) Shall be supplied complete with all accessories, features and devices required for operation and configuration of a computer monitor, connection to the KVM switches and power outlets and mounting/positioning brackets and accessories irrespective of whether these components are stated in these schedules or not.

(g) The offered LCD monitor shall be enterprise grade designed for 24/7 operation at the following environmental conditions:

(i) Temperature: 0 to 35°C (continuous)

(ii) Altitude: ≥ 1000mASL

(iii) Installation location: indoor with natural aeration only

5.4.3.2.2 **Minimum Specifications**

Shall meet the following

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel size</td>
<td>27.0 inch (68.5 cm)</td>
</tr>
<tr>
<td>2</td>
<td>Native resolution</td>
<td>≥ 2560 x 1440</td>
</tr>
<tr>
<td>3</td>
<td>brightness</td>
<td>≥350cd/m²</td>
</tr>
<tr>
<td>4</td>
<td>Contrast ratio</td>
<td>≥1000:1</td>
</tr>
<tr>
<td>5</td>
<td>Viewing angle</td>
<td>≥170°(V) / 160°(H)</td>
</tr>
<tr>
<td>6</td>
<td>Display colours</td>
<td>≥16.7 M (True 8bit)</td>
</tr>
<tr>
<td>7</td>
<td>Number of Video input ports</td>
<td>≥ Three (3)</td>
</tr>
<tr>
<td>8</td>
<td>Type of Video input ports</td>
<td>HDMI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DVI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shall have at least one of each type</td>
</tr>
<tr>
<td>9</td>
<td>Audio Speakers</td>
<td>≥2W x 2 stereo</td>
</tr>
<tr>
<td>10</td>
<td>Audio inputs and outputs</td>
<td>One 3.5mm audio in and one 3.5mm audio out</td>
</tr>
<tr>
<td>11</td>
<td>Display tilt</td>
<td>-5° - +20°</td>
</tr>
<tr>
<td>12</td>
<td>Swivel (angle)</td>
<td>+60° ~ -60°</td>
</tr>
<tr>
<td>13</td>
<td>Pivot (angle/direction)</td>
<td>90 ° (clockwise)</td>
</tr>
<tr>
<td>14</td>
<td>Height adjustment</td>
<td>0-120mm</td>
</tr>
<tr>
<td>15</td>
<td>Power supply</td>
<td>Internal 220–240V AC, 50Hz power supply unit.</td>
</tr>
<tr>
<td>16</td>
<td>Power supply Cord</td>
<td>C13/C14 to BS1363 (IEC type G-British type) plug</td>
</tr>
<tr>
<td>17</td>
<td>Operating temperature</td>
<td>0 to 40°C continuous</td>
</tr>
</tbody>
</table>
5.4.3.2.3 **Product Certifications**

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided.

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

5.4.3.3 **Two-port dual display KVM switch**

5.4.3.3.1 **General Requirements**

(a) Shall be used to connect the two LCD monitors at the operator desk.

(b) Shall be connected to the two Thin client PC video &USB outputs and its outputs connected to the two LCD displays, keyboard and mouse.

(c) At minimum it shall have four Video inputs and two video outputs. Four USB outputs and two USB inputs.

(d) The switch will be positioned at the operator desk.

(e) The KVM switch video inputs MUST be compatible with the Thin client PC display outputs.

(f) The KVM switch shall support touch input from two touch Monitors to the connected devices in a similar fashion to the keyboard.

(g) Each KVM switch shall contain a console port for configuration and management. If software is required for configuration of the switch it MUST be provided.

(h) KVM switches shall be supplied complete with all accessories, features and devices required for connection of dual display monitors, keyboard & mouse to two dual display output from thin client PC’s irrespective of whether these components are stated in these specifications or not.

(i) The offered KVM switches shall be enterprise grade designed for 24/7 operation at the following environmental conditions:

(i) Temperature: 0 to 35°C (continuous)

(ii) Altitude: ≥ 1000mASL

(iii) Installation location: indoor with natural aeration only.
### Minimum specifications

Shall meet the following:

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of host computer input connections</td>
<td>≥ Two (2)</td>
</tr>
<tr>
<td>2</td>
<td>Number of video inputs</td>
<td>≥ Four (4) (two dual display inputs)</td>
</tr>
<tr>
<td>3</td>
<td>Number of displays supported</td>
<td>≥ Two (2) (dual display support)</td>
</tr>
<tr>
<td>4</td>
<td>Maximum video resolution supported</td>
<td>≥ 1920 x 1200@60Hz</td>
</tr>
<tr>
<td>5</td>
<td>Type of display ports supported by the switch.</td>
<td>DVI or DP or HDMI (the type of video input and output ports MUST be compatible with the KVM extender video outputs, bidder to specify ports on offer)</td>
</tr>
<tr>
<td>6</td>
<td>Number USB input ports</td>
<td>≥ two (2), one per PC input.</td>
</tr>
<tr>
<td>7</td>
<td>Number of USB ports on the KVM switch for connection of keyboard, mouse and other peripherals</td>
<td>≥ Four (4)</td>
</tr>
<tr>
<td>8</td>
<td>USB type supported</td>
<td>USB 2.0 &amp; USB 1.1 must be supported</td>
</tr>
<tr>
<td>9</td>
<td>Output (console) Audio terminals</td>
<td>Two 3.5mm audio in and two 3.5mm audio out</td>
</tr>
<tr>
<td>10</td>
<td>Input (host) Audio terminals</td>
<td>Four 3.5mm audio in and four 3.5mm audio out</td>
</tr>
<tr>
<td>11</td>
<td>Port selection</td>
<td>Hotkey, Pushbutton</td>
</tr>
<tr>
<td>12</td>
<td>LEDs Device On</td>
<td>One (1) Green</td>
</tr>
<tr>
<td>13</td>
<td>LEDs Video input on Line/Selected</td>
<td>Four (4) Red and Four (4) Green</td>
</tr>
<tr>
<td>14</td>
<td>Power supply</td>
<td>220-240V AC, 50Hz internal or external power supply unit.</td>
</tr>
<tr>
<td>15</td>
<td>Power supply Cord</td>
<td>C13/C14 to BS1363 (IEC type G-British type) plug</td>
</tr>
<tr>
<td>16</td>
<td>Operating temperature</td>
<td>0 to 40ºC continuous</td>
</tr>
</tbody>
</table>
### 5.4.3.3 Product Certifications

(a) Device must be tested and approved for use in the EU or USA or Canada. Proof of testing and certification MUST be provided.

(b) Product certification from an EU or USA or Canada reputable firm MUST be provided along with the bid.

### 5.4.4 PLC PANEL EQUIPMENT

#### 5.4.4.1 Panel Touch Screen Industrial PC

Contractor shall supply Schneider HMIPSPS952D1801 (similar to existing model) or other equivalent touch screen panel PC meeting the minimum technical specifications given below.

#### 5.4.4.1.2 Minimum specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor type</td>
<td>Intel® Core ® series</td>
</tr>
<tr>
<td>2</td>
<td>No of processors &amp; sockets</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>3</td>
<td>No of cores on each processor</td>
<td>≥two (2)</td>
</tr>
<tr>
<td>4</td>
<td>No of threads on each processor</td>
<td>≥four (4)</td>
</tr>
<tr>
<td>5</td>
<td>Processor Base Frequency</td>
<td>≥ 1.7 GHz</td>
</tr>
<tr>
<td>6</td>
<td>Processor Cache</td>
<td>≥ 3MB</td>
</tr>
<tr>
<td>7</td>
<td>Processor TDP</td>
<td>≤20W</td>
</tr>
<tr>
<td>8</td>
<td>Installed RAM type</td>
<td>≥DDR3 ECC,</td>
</tr>
<tr>
<td>9</td>
<td>Total installed RAM</td>
<td>≥ 8GB</td>
</tr>
<tr>
<td>10</td>
<td>Type of installed drives</td>
<td>Industrial Grade SLC with 10-year warranty</td>
</tr>
<tr>
<td>11</td>
<td>Size of installed SSD drive/s</td>
<td>≥ 80GB</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>Network controllers</td>
<td>One (1) dual port 1GB Base-T Ethernet controller</td>
</tr>
<tr>
<td>13</td>
<td>Total number 1GB Base-T Ethernet ports (RJ45)</td>
<td>≥ two (2)</td>
</tr>
<tr>
<td>14</td>
<td>Operating system</td>
<td>OEM pre-installed and pre-configured Windows 10 IoT Enterprise 64 bit</td>
</tr>
<tr>
<td>15</td>
<td>Display size</td>
<td>≥ 17 inch &amp; ≤ 19 inch</td>
</tr>
<tr>
<td>16</td>
<td>Display colour</td>
<td>≥ 16777216 colours</td>
</tr>
<tr>
<td>17</td>
<td>Luminance</td>
<td>≥ 300 cd/m²</td>
</tr>
<tr>
<td>18</td>
<td>Pixel resolution</td>
<td>≥ 4096 x 4096</td>
</tr>
<tr>
<td>19</td>
<td>Video controller type</td>
<td>Intel HD Graphics</td>
</tr>
<tr>
<td>20</td>
<td>Display type</td>
<td>LED backlight, touch screen, Colour TFT LCD</td>
</tr>
<tr>
<td>21</td>
<td>Aspect ratio 16:9</td>
<td>16:9</td>
</tr>
<tr>
<td>22</td>
<td>Display resolution</td>
<td>1366 x 768 pixels WXGA</td>
</tr>
<tr>
<td>23</td>
<td>View angle horizontal x vertical</td>
<td>160 x 170°</td>
</tr>
<tr>
<td>24</td>
<td>Touch panel type</td>
<td>Projected capacitive technology (PCT)</td>
</tr>
<tr>
<td>25</td>
<td>Type of cooling</td>
<td>Passive/ Fan less</td>
</tr>
<tr>
<td></td>
<td><strong>FANS SHALL NOT BE ACCEPTABLE</strong></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Mechanical robustness</td>
<td>7H hardness anti-scratch</td>
</tr>
<tr>
<td>27</td>
<td>Touch screen water resistance</td>
<td>Operate with water on screen</td>
</tr>
<tr>
<td>28</td>
<td>PCIe Expansion slots- mini PCIe</td>
<td>≥ one (1)</td>
</tr>
<tr>
<td>29</td>
<td>USB ports</td>
<td>≥ Two (2) front ports</td>
</tr>
<tr>
<td>30</td>
<td>Video ports:</td>
<td>≥ one (1) HDMI</td>
</tr>
<tr>
<td>31</td>
<td>Serial ports</td>
<td>≥ one (1) RS232</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ one (1) RS 485</td>
</tr>
<tr>
<td>32</td>
<td>Power supply type</td>
<td>Internal 24V DC input</td>
</tr>
<tr>
<td>33</td>
<td>Power input rating</td>
<td>24V DC ±20 %</td>
</tr>
<tr>
<td>33</td>
<td>Device maximum power consumption</td>
<td>≤ 60W</td>
</tr>
<tr>
<td>34</td>
<td>Front panel IP degree of</td>
<td>IP66 front</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>35</td>
<td>Design and type test Standards</td>
<td>CISPR 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 60950</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 61000-6-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 61000-6-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UL 60950</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FCC part 15 class A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSA C22.2 No 60950</td>
</tr>
<tr>
<td>36</td>
<td>Compliant Product certifications &amp; directives</td>
<td>2004/108/EC - electromagnetic compatibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006/95/EC - low voltage directive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2011/65/EU - RoHS directive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1907/2006/EC - REACH directive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012/19/EU - WEEE directive</td>
</tr>
<tr>
<td>37</td>
<td>Continuous operating ambient temperature</td>
<td>0°C to +55°C</td>
</tr>
<tr>
<td>38</td>
<td>Operating Relative Humidity (non-condensing)</td>
<td>10 to 95%</td>
</tr>
<tr>
<td>39</td>
<td>Operating altitude without derating</td>
<td>≥2000 m</td>
</tr>
<tr>
<td>40</td>
<td>Operating Environment</td>
<td>Pollution Degree: 2</td>
</tr>
<tr>
<td>41</td>
<td>Vibration resistance</td>
<td>≥1 gn, 5...500 Hz</td>
</tr>
<tr>
<td>42</td>
<td>Manufacturer Warranty</td>
<td>≥5 years</td>
</tr>
</tbody>
</table>

5.4.4.2 Digital Power & Energy Meter

5.4.4.2.1 Contractor shall supply Schneider PM8000 - METSEPM8244 + two METSEPM89M0024 or other equivalent meter meeting the minimum technical specifications given below

5.4.4.2.2 Meter shall consist of a DIN mount meter unit, two analogue output units and a panel mount remote display unit

5.4.4.2.3 Digital meters shall provide bi-directional 4-quadrant energy and power metering. Shall measure and display:

(a) kWh, kVARh, kVAh delivered and received

(b) Half cycle (10ms) instantaneous values per phase and totals per phase for
Ten (i) Voltage and current
der (ii) Apparent power (kVA), active power (kW) and reactive power (kVAR)
for supply of SCADA hardware
for seven forks & Turkwel hydroelectric power
plants

(iii) Power factor and frequency
(iv) Voltage and current unbalance

5.4.4.2.4 The meters shall be site programmable/configurable for scaling, range set up etc. They shall have at least four buttons on the display unit for this purpose. Meter configuration software shall be supplied and installed into two laptops with perpetual license.

5.4.4.2.5 Shall meet accuracy class of
(a) Class 0.2s (active energy according to IEC 62053-22)
(b) Class 0.2 (active power according to IEC 61557-12)
(c) Class 0.5s (reactive energy according to IEC 62053-24)
(d) Class 0.5 (power factor according to IEC 61557-12)
(e) Class 0.2 (voltage according to IEC 61557-12)
(f) Class 0.2 (current according to IEC 61557-12)

5.4.4.2.6 Shall have two fast Ethernet port 100base-T and support Modbus TCP

5.4.4.2.7 Shall have a remote large graphical LCD backlit display (at least 320 x 240 pixels)

5.4.4.2.8 They Shall meet the following minimum specifications

| (a) Measuring inputs |
| Measurement rate | continuous |
| Rated AC input voltage | Phase-to-neutral (L-N): 400 V AC  |
| | Phase-to-phase (L-L): 690 V AC |
| voltage input type | Direct connection or voltage transformers |
| Rated AC input current | 0.05A – 10A |
| Nominal Input current | 3 phase AC 1A/5A selectable |
| Current input type | from current transformers |
| Surge withstand capability | 20A continuous |
| | 100 A for 1 s |
| Connection type | 3P4W i.e. 3 phases, 4 conductors |
| Frequency Range | 42-69Hz |

| (b) Measuring accuracy |
| Measured variable | Accuracy class acc. to IEC 61557-12 |
| RMS Voltage | 0.2 |
| RMS current | 0.2 |
| Apparent power | 0.5 |
Ten tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

| Active power | 0.2 |
| Reactive power (VAR) | 1.0 |
| \( \cos \varphi \) | 0.20% |
| Power factor | 2 |
| Phase angle | +/-1° |
| Frequency | 0.1 |
| Apparent energy | 0.5 |
| Active energy | 0.2 |
| Reactive energy | 0.5 |

(c) Power supply

| Rated range | 95 ... 240 V AC (50Hz) or 110 ... 340 V DC |
| Nominal | 110VDC ± 20% |
| Power consumption | < 20 VA |

(d) Remote Display unit

| Type | backlit, colour, graphical LCD |
| Resolution | 320 x 240 pixels – QVGA |
| Size W X H | at least 72 mm x 54 mm |
| keyboard | at least four keys for Parameterization and viewing |
| Parameterization | Menu-driven parameterization and operation |

(e) Digital & Analogue inputs and outputs

| Number digital inputs | at least two (2) |
| Number digital inputs | at least one (1) |
| Digital Input & outputs rating | 24VDC |
| Number of analogue outputs | Four (4) |
| Type of analogue outputs | 4–20mA |
| Analogue input rating | 24V DC |

(f) Communication

| Interface | Ethernet 10/100 base-TX (fast Ethernet) |
| protocol | Modbus TCP/IP, IEC61850, SNMP |

(g) Connections

<p>| Type | Screw terminals |
| measuring and power supply terminals | Solid 1 x 0.5 ... 4.0 mm² 2 x 0.5 ... 2.5 mm² |
| | Finely stranded with end sleeve 1 x 0.5 ... 2.5 mm² 2 x 0.5 ... 1.5 mm² |
| Digital inputs &amp; outputs | Solid 1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1.0 mm² |
| | Finely stranded with end sleeve 1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1.5 mm² |</p>
<table>
<thead>
<tr>
<th><strong>Ethernet</strong></th>
<th>RJ45(8P8C)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(h) Enclosure (display unit)</strong></td>
<td></td>
</tr>
<tr>
<td>Housing design</td>
<td>Switching panel housing to IEC 61554</td>
</tr>
<tr>
<td>Housing dimensions W x H</td>
<td>96 mm x 96 mm</td>
</tr>
<tr>
<td>Overall depth</td>
<td>&lt;60 mm</td>
</tr>
<tr>
<td>Mounting position</td>
<td>vertical</td>
</tr>
<tr>
<td>Degree of protection according to IEC 60529</td>
<td>Front: IP65</td>
</tr>
<tr>
<td></td>
<td>Rear: IP20</td>
</tr>
<tr>
<td><strong>(i) Environmental conditions</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>Operating temperature - 10 °C to + 55 °C</td>
</tr>
<tr>
<td></td>
<td>Storage and transport temperature, - 25 °C to + 70 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>95% at 25°C without condensation (normal conditions)</td>
</tr>
<tr>
<td>Operating altitude above sea level</td>
<td>up to 2000m or higher</td>
</tr>
<tr>
<td>Degree of pollution</td>
<td>2</td>
</tr>
<tr>
<td><strong>(j) Functions and Features</strong></td>
<td></td>
</tr>
<tr>
<td>Measurement values</td>
<td>Derivation of various RMS power parameters from the basic measured variables with maximum and minimum values, as well as mean values for phase-to-neutral voltages, phase-to-phase voltages and currents.</td>
</tr>
<tr>
<td></td>
<td>Phase-to-phase voltage, Phase-to-neutral voltage, Current, Apparent power per phase, Active power per phase import/export, Reactive power per phase positive/negative, Total apparent power, Total active power import/export, Total reactive power positive/negative, Power factor, Total power factor, Line frequency, THD voltage, THD current, Active energy import / export, Reactive energy positive4 / negative, Apparent energy</td>
</tr>
<tr>
<td>Counters and power demand</td>
<td>Accessible registers for all measured values</td>
</tr>
<tr>
<td>A total of 10 energy counters capture active energy, reactive energy, apparent energy for off-peak and on-peak, import and export Counters and power demand</td>
<td></td>
</tr>
<tr>
<td>Calculation and storage of the last demand period mean value for active power and reactive power for simple generation of load profiles using software. Programmable demand period from 1 to 60 mins.</td>
<td></td>
</tr>
<tr>
<td>Tender for supply of SCADA hardware for seven forks &amp; Turkwel hydroelectric power plants</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Configurable universal counter</strong></td>
<td>For counting limit violations and status changes at the digital input or output, or for indicating the active power or reactive power of a connected pulse encoder.</td>
</tr>
<tr>
<td><strong>Working hours’ counter</strong></td>
<td>For monitoring the runtime of a connected load.</td>
</tr>
<tr>
<td><strong>Monitoring functions</strong></td>
<td>Monitoring of 6 limit values. The limit values can be combined according to logic AND/OR. A group message that indicates the violation of at least one limit value can be generated using an OR operation.</td>
</tr>
<tr>
<td></td>
<td>Phase sequence monitor.</td>
</tr>
<tr>
<td></td>
<td>Status monitoring of the digital input.</td>
</tr>
<tr>
<td></td>
<td>Monitoring the operating status of the meter.</td>
</tr>
<tr>
<td><strong>Input &amp; outputs</strong></td>
<td>Multifunctional digital input for tariff changing, demand period synchronization, status monitoring or acquisition of energy pulses from third-party devices.</td>
</tr>
<tr>
<td></td>
<td>Multifunctional digital output, programmable as energy pulse output for active energy or reactive energy pulses, for showing the direction of rotation, indicating the working hours of the meter, outputting limit violations, or as a switching output for remote control via PC.</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EMC for industrial sector: IEC 61000-6-2 respectively IEC 61326-1:2005, table 2</td>
</tr>
<tr>
<td></td>
<td>EMC against unloading: IEC 61000-4-2: 2001-04</td>
</tr>
<tr>
<td></td>
<td>EMC against high frequency fields: IEC 61000-4-3: 2006-02</td>
</tr>
<tr>
<td></td>
<td>EMC against conducted LF disturbance variables (industry): IEC 61000-6-4</td>
</tr>
<tr>
<td></td>
<td>EMC against conducted disturbance variables via HF fields: IEC 61000-4-6: 2001-12</td>
</tr>
<tr>
<td></td>
<td>EMC against magnetic fields with power engineering frequencies: IEC 61000-4-8: 2001-03</td>
</tr>
<tr>
<td></td>
<td>EMC against quick, transient electrical disturbances: IEC 61000-4-4: 2005-07</td>
</tr>
<tr>
<td></td>
<td>EMC against voltage drops and interruptions: IEC 61000-4-11: 2004-03</td>
</tr>
<tr>
<td></td>
<td>EMC against surge voltages: IEC 61000-4-5: 2001-12</td>
</tr>
<tr>
<td></td>
<td>Pulse emitter: according to IEC62053-31</td>
</tr>
<tr>
<td>Mechanical dynamic</td>
<td>Low-temperature test: DIN EN 60068 Part 2-1:1995-03</td>
</tr>
</tbody>
</table>
### Stress Conditions

<table>
<thead>
<tr>
<th>Stress Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibratory load (conditions of use)</td>
<td>IEC 60068 Part 2-6:1995-03 / EN 60068 Part 2-6:1996-05</td>
</tr>
<tr>
<td>Vibratory load (transport conditions)</td>
<td>IEC 60068 Part 2-6:1995-03 / EN 60068 Part 2-6:1996-05</td>
</tr>
<tr>
<td>Seismic conditioning (conditions of use)</td>
<td>IEC 60068 Part 3-3:1991-02 / EN 60068 Part 3-3:1993-09</td>
</tr>
<tr>
<td>Mechanical stability against bump and impact</td>
<td>IEC 60068-2-75:1997-08</td>
</tr>
<tr>
<td>Free fall of the unpacked device (transport conditions)</td>
<td>IEC 60068-2-32:1975</td>
</tr>
</tbody>
</table>

### 5.4.5 Cyber Security

#### 5.4.5.1 General Requirements

5.4.5.1.1 Contractor shall supply cyber security equipment and engineering services for setting up and deploying a cyber security solution suited for SCADA network (OT) interfaced to the corporate/office (IT) network.

5.4.5.1.2 The offered solution shall be delivered in a unified platform with consolidated security management across both IT and OT networks.

5.4.5.1.3 In order to ensure the unified solution mitigates attacks at each step of the cyber-kill chain, the chosen solution must meet the given requirements.

5.4.5.1.4 Scope of works

   (a) Provision of cyber security appliances and software as detailed in clauses 5.2.4.6, 5.2.3.6 and 5.2.10.3

   (b) Installation, configuration and testing of the cyber security appliances and server prior to delivery

   (c) In depth training on cyber security as detailed in the proceeding clauses
(d) Commissioning of the entire cyber security infrastructure after panel installation by the procuring entity. Commissioning shall involve:

(i) Modifying all settings to suite the procuring entity applications and users.

(ii) Configure active/active redundancy for all security appliances/gateways in the network

(iii) Initialise all cyber security services in the network

(iv) Test the configured settings and services and optimise them for best security, performance and reliability

(v) Development and deployment of cyber security policies for devices and users.

(vi) Carry out any necessary configurations in the servers, ethernet switches, industrial PC’s, virtual machines etc. necessary for optimal security solution

5.4.5.1.5 All Cyber security solution services **MUST** be conducted together with the procuring entity personnel. All actions carried out by the contractor shall be done together with the procuring entity personnel. No action during commissioning shall be carried out in absence of the procuring entity personnel

5.4.5.1.6 All Cyber security equipment and services **MUST** be from the same vendor

5.4.5.2 **Technical Evaluation criteria for the cyber security solution**

5.4.5.2.1 The contractor may subcontract the cyber security solution to a firm with experience on cyber security solutions. The bidder may also form a joint venture with such a company.

5.4.5.2.2 For the purposes of this tender the cyber security solution provider shall be either be the main contractor/bidder, partner in a joint venture or a subcontractor chosen to deliver the cyber security solution

5.4.5.2.3 All Cyber security equipment and services **MUST** be from the same vendor

5.4.5.2.4 The Cyber security solution provider shall meet the following criteria:

(a) The cyber security solution vendor MUST have a minimum of 10 years in the security market. *(bidder to attach and reference a publicly accessible document)*

(b) The cyber security solution vendor MUST have a local office with local personnel capable of handling OT and IT security solutions maintenance and support *(bidder to attach business permit of the local Kenyan office and CV’s of local Kenyan personnel available for cyber security support)*
(c) The cyber security solution vendor **MUST** attach and reference at least **five (5)** published Gartner Magic Quadrant (MQ) reports over the last 5 years that show the vendor’s **leadership positions** in Enterprise Network Firewalls. *(bidder to attach at least five published reports)*

(d) The cyber security solution vendor **MUST** attach and reference at least **Three (3)** published NSS labs NGFW test reports over the last 3 years that show the vendor’s solution/platform overall exploit block rate of over **98%**. *(bidder to attach at least three published reports)*

(e) The cyber security solution vendor **MUST** attach and reference at least **Two (2)** published NSS Labs Breach Prevention reports over the last three years showing the vendors solution/platform has a security effectiveness of over **98%**. *(bidder to attach at least two published reports)*

5.4.5.2.5 The bidder **MUST** provide a unified gateway that has: *(technical data sheet brochure to be provided)*

(a) Intrusion Prevention System (IPS)
(b) Application Control with over 5,000 web 2.0 applications
(c) Threat Emulation with OS and CPU level inspection.
(d) Threat Extraction to scrub files of active content.
(e) URL Filtering supporting enforcement of timed access to sites and the ability to educate users.
(f) Anti-Bot and Anti-Virus. Analysing over 200 million addresses for bots and more than 250,000 websites
(g) Anti-Spam and Email.
(h) IPSec VPN with support for multiple authentication options such as User Certificates, CAPI, one-time tokens, software and hardware smartcards
(i) Mobile Access for at least 5 concurrent users, for SSL access to corporate web applications
(j) Identity Awareness for visibility into users’ and group activity.
(k) Management of security policies from a single pane of glass
(l) Governance Risk and Compliance monitoring and reporting.

5.4.5.3 **Technical Specifications cyber Security Functions**

5.4.5.3.1 **General requirements**

(a) bidder shall in their offer attach a publicly accessible reference document confirming that their security solution meets all the requirements in the subsequent sub clauses of clause 5.4.5.3
(b) The offered solution/software/platform shall meet all the requirements and offer all the services in the subsequent sub clauses of clause 5.4.5.3. However, services which must be licensed/activated (to be costed by bidder) are as per clauses 5.4.5.4.1, 5.4.5.5.1 and 5.4.5.6.2. Functions not listed in these clauses such as sandboxing and file scrubbing etc. may be activated by the employer at a later date as per vendors’ terms, but they **MUST** be included in the bidder’s solution. These services however need not be costed a long with this bid.

5.4.5.3.2 **Firewall**

(a) The security appliances must use Stateful Inspection based on granular analysis of communication and application state to track and control the network flow.

(b) Solution must support access control for at least 150 predefined/services/protocols

(c) Must provide security rule hit count statistics to the management application.

(d) Must allow security rules to be enforced within time intervals to be configured with an expiry date/time.

(e) The firewall must support user, client and session authentication methods.

(f) The following user authentication schemes must be supported by the security gateway and VPN module: tokens (i.e. -SecureID), TACACS, RADIUS and digital certificates

(g) IPv6 Support

(i) Solution must support IPv6 traffic handling on IPS and APP module, Firewall, Identity Awareness, URL Filtering, Antivirus and Anti-Bot

(ii) Solution must Support 6 to 4 NAT, or 6 to 4 tunnels

(iii) Solution must support AD integration using IPv6 traffic

5.4.5.3.3 **Intrusion Prevention System**

(a) IPS must leverage software-based acceleration technologies to deliver security and performance.

(b) IPS must have mechanism of validating RFC compliance of protocols and checking anomalies

(c) IPS must provide geo-protections to allow the administrator to easily block inbound and/or outbound traffic based on countries.
(d) IPS must be based on the following detection mechanisms: exploit signatures, protocol anomalies, application controls and behaviour-based detection

(e) IPS must be able to fail open during high load.

(f) IPS must be integrated with firewall, application control, URL filtering, Antibot and Sandboxing features on a unified platform.

(g) The IPS vendor must supply evidence of leadership in protecting Microsoft vulnerabilities.

(h) IPS must support consolidated management on a single pane of glass.

5.4.5.3.4 **Anti-Bot and Anti-Virus**

(a) Solution must have an integrated Anti-Bot and Anti-Virus

(b) Antibot must be able to detect bots and block communication to command and control sites.

(c) Anti-Bot and Anti-Virus policy must be administered from a central console

(d) Anti-virus must leverage a cloud database with over 4 million malware signatures.

5.4.5.3.5 **Sandboxing and File Scrubbing**

(a) Solution offered MUST support on premise sand boxing and file scrubbing

(b) Sandboxing must perform deep CPU-level inspection in order to stop the most dangerous attacks before malware has opportunity to deploy and evade detection.

(c) Sandboxing must use OS-level inspection to examine a broad range of file types, including executables and data files.

(d) Sandboxing must provide option for running as a cloud-based service or running on premise.

(e) File scrubbing must support removal of active content and other exploitable content from infected documents.

(f) File scrubbing must provide the option to convert reconstructed files to PDF or to keep the original format.

(g) Sandboxing must support emulation of over 40 file types including; flash, Java Applets, PIF, exe, Microsoft office and Adobe PDF.

(h) Sandboxing and File scrubbing solution must support deployment as a Mail Transfer Agent.

5.4.5.3.6 **Email Security (Antispam)**

(a) Anti-Spam and Email security application must be content/format and language agnostic
(b) Antispam must include an antivirus engine that scans mail protocols such as SMTP and POP3.
(c) The Anti-Spam and Email security application must include IP and content reputation checks.
(d) Solution must have the option to include a Zero-hour protection mechanism for new viruses spread through email and spam without relying solely in heuristic or content inspection

5.4.5.3.7 **Security Management**

(a) Security management application must be able to co-exist on the security gateway as an option.
(b) Security management must support unified management of both physical and virtual networks, endpoints and Office365
(c) Security management must support concurrent administration.
(d) Security management must support integration with LDAP-based information stores to centralize user management.
(e) Security management must provide browser-based access to administrators and auditors to view policies, gateway status and user administration.
(f) Security Management must provide APIs to enable self-service and automated workflows.
(g) Security management must support central management of policy change management with review and audit capabilities of policy changes.
(h) Security management must enable administrators to action on identified events such as by blocking it immediately.
(i) Security management must support management of endpoint security.
(j) The Log analysing must support creation of custom log queries. (Must attach and reference a publicly accessible datasheet)

5.4.5.3.8 **Data Loss Prevention (DLP)**

(a) The gateway must have an option to add an integrated Data Loss Prevention application.
(b) The vendor should have an option to provide a fully integrated secure mobility solution on the next generation firewall.

5.4.5.3.9 **Best Practice Governance Risk and Compliance (GRC)**

(a) Vendor must have an option to provide a fully integrated Governance Risk and Compliance application
(b) Vendor must have an option for Real Time Compliance Monitoring across all security services in the product
Ten tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

(c) Vendor must have an option to deliver real-time assessment of compliance with major regulations (PCI-DSS, HiPPA, SOX...)
(d) Vendor must have an option for Instant notification on policy changes impacting compliance
(e) Vendor must have an option to Provide actionable recommendations to improve compliance
(f) Vendor must have an option to recommend Security Best Practices

5.4.5.4 **Enterprise Grade Cyber Security Appliance (Gateway)**

5.4.5.4.1 **Cyber security applications/functions**

The security appliance shall have a minimum of the following licensed functions:
(a) **Firewall** meeting requirements of clause 5.4.5.3.2 and with perpetual license
(b) **Identity Awareness** (identity services for identity-based firewall policy) with perpetual license
(c) **IPsec VPN** with perpetual license.
(d) **Intrusion Prevention System (IPS)** meeting requirements of clause 5.4.5.3.3 and with perpetual license or minimum three-year subscription license (bidder to specify the offered license)
(e) **Advanced Networking & Clustering** for optimum performance and high availability (QoS prioritisation, load sharing and balancing, redundancy etc.) with perpetual license.
(f) **Mobile access** (Secure SSL VPN access, two-factor authentication, Device/end-user pairing etc) for safe remote access from mobile devices and with perpetual license
(g) **Application control for SCADA/ICS protocols** and devices with visibility to a minimum of the following protocols
   (i) IEC-60870-5-104
   (ii) IEC 60870-6 (ICCP)
   (iii) IEC 61850
   (iv) Modbus
   (v) OPC
   (vi) Profinet
   (vii) S7 (Siemens)

With **perpetual license** or minimum **three-year subscription license** (bidder to specify the offered license)
(h) **URL Filtering** with perpetual license or minimum three-year subscription license (bidder to specify the offered license)

(i) **Antivirus** meeting requirements of [clause 5.4.5.3.4](#), with perpetual license or minimum three-year subscription license (bidder to specify the offered license)

(j) **Anti-Spam** meeting requirements of [clause 5.4.5.3.6](#), with perpetual license or minimum three-year subscription license (bidder to specify the offered license)

(k) **Anti-Bot** meeting requirements of [clause 5.4.5.3.4](#), with perpetual license or minimum three-year subscription license (bidder to specify the offered license)

### 5.4.5.4.2 Minimum Performance & Hardware specifications

Each enterprise security Appliance/gateway in scope of supply shall meet the following minimum specification

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Firewall throughput</td>
<td>≥10 Gbps</td>
</tr>
<tr>
<td>2</td>
<td>IPS throughput</td>
<td>≥2.4 Gbps</td>
</tr>
<tr>
<td>3</td>
<td>AES-128 VPN throughput</td>
<td>≥1.6 Gbps</td>
</tr>
<tr>
<td>4</td>
<td>Firewall, Application Control and IPS throughput, services running concurrently</td>
<td>≥2 Gbps</td>
</tr>
<tr>
<td>5</td>
<td>Full Threat Prevention (Firewall, Application Control, URL Filtering, IPS, Antivirus, Anti-Bot and Sandblast) throughput</td>
<td>≥700 Mbps</td>
</tr>
<tr>
<td>6</td>
<td>Processor</td>
<td>≥Dual core</td>
</tr>
<tr>
<td>7</td>
<td>Memory</td>
<td>≥16GB</td>
</tr>
<tr>
<td>8</td>
<td>Storage</td>
<td>≥240GB SSD</td>
</tr>
<tr>
<td>9</td>
<td>Total number 1GB Base-T Ethernet ports (RJ45)</td>
<td>≥six (6)</td>
</tr>
<tr>
<td>10</td>
<td>Device management console Ethernet port</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>11</td>
<td>Lights Out Management Ethernet port</td>
<td>≥One (1)</td>
</tr>
<tr>
<td>12</td>
<td>Remote device Management</td>
<td>(i) HTTPS Web Interface</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>and monitoring protocol support</td>
<td>(ii) SNMP v1/v2c/v3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) syslog</td>
</tr>
<tr>
<td>13</td>
<td>User management</td>
<td>Microsoft AD, LDAP, RADIUS, Cisco pxGrid,</td>
</tr>
<tr>
<td>14</td>
<td>Concurrent connections</td>
<td>≥3 Million</td>
</tr>
<tr>
<td>15</td>
<td>Connections per second</td>
<td>≥110,000</td>
</tr>
<tr>
<td>16</td>
<td>Redundancy</td>
<td>Active/Active and Active/Passive</td>
</tr>
<tr>
<td>17</td>
<td>Power supply unit type</td>
<td>internal</td>
</tr>
<tr>
<td>18</td>
<td>Power supply unit rating</td>
<td>≥250W</td>
</tr>
<tr>
<td>19</td>
<td>Power input rating</td>
<td>110–240V AC, 50Hz</td>
</tr>
<tr>
<td>20</td>
<td>Enclosure type</td>
<td>Steel or metallic equivalent</td>
</tr>
<tr>
<td>21</td>
<td>Enclosure Protection as per IEC 60529</td>
<td>≥IP20</td>
</tr>
<tr>
<td>22</td>
<td>Mounting:</td>
<td>Rack type</td>
</tr>
<tr>
<td>23</td>
<td>Form factor (fully configured):</td>
<td>1U</td>
</tr>
<tr>
<td>24</td>
<td>Mounting accessories</td>
<td>Rack slide rails to be provided</td>
</tr>
<tr>
<td>25</td>
<td>Continuous ambient operating temperature</td>
<td>−5°C to +40°C</td>
</tr>
<tr>
<td>26</td>
<td>Operating Relative Humidity (non-condensing)</td>
<td>5 to 95%</td>
</tr>
<tr>
<td>27</td>
<td>Operating altitude without derating</td>
<td>≥1000 m</td>
</tr>
<tr>
<td>28</td>
<td>Manufacturer Warranty</td>
<td>≥3 years</td>
</tr>
</tbody>
</table>

5.4.5.5 **Industrial Grade Cyber Security Appliance**

5.4.5.5.1 **Cyber security applications/functions**

The security appliance shall have a minimum of the following licensed functions:

(a) **Firewall** meeting requirements of clause 5.4.5.3.2 and with perpetual license
(b) **Identity Awareness** (identity services for identity-based firewall policy) with perpetual license

(c) **IPsec VPN** with perpetual license.

(d) **Intrusion Prevention System (IPS)** meeting requirements of clause 5.4.5.3.3 and with perpetual license or minimum three-year subscription license (bidder to specify the offered license)

(e) **Advanced Networking & Clustering** for optimum performance and high availability (QoS prioritisation, load sharing and balancing, redundancy etc.) with perpetual license.

(f) **Mobile access** (Secure SSL VPN access, two-factor authentication, Device/end-user pairing etc) for safe remote access from mobile devices and with perpetual license

(g) **Application control for SCADA/ICS protocols** and devices with visibility to a minimum of the following protocols

(i) IEC-60870-5-104  
(ii) IEC 60870-6 (ICCP)  
(iii) IEC 61850  
(iv) Modbus  
(v) OPC  
(vi) Profinet  
(vii) S7 (Siemens)

With perpetual license or minimum three-year subscription license (bidder to specify the offered license)

#### 5.4.5.5.2 Minimum Performance & Hardware Specifications

Each industrial security Appliance/gateway in scope of supply shall meet the following minimum specification

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Firewall throughput</td>
<td>≥2 Gbps</td>
</tr>
<tr>
<td>2</td>
<td>VPN throughput</td>
<td>≥450Mbps</td>
</tr>
<tr>
<td>3</td>
<td>Firewall, Application Control and IPS throughput, services running concurrently</td>
<td>≥60 Mbps</td>
</tr>
<tr>
<td>4</td>
<td>Full Threat Prevention (Firewall, Application Control, URL Filtering, IPS, Antivirus, Anti-Bot and)</td>
<td>≥20 Mbps</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Concurrent connections</td>
<td>$\geq 400,000$</td>
</tr>
<tr>
<td>6</td>
<td>Connections per second</td>
<td>$\geq 10$</td>
</tr>
<tr>
<td>7</td>
<td>Total number 1GB Base-T Ethernet ports (RJ45)</td>
<td>$\geq$ six (6)</td>
</tr>
<tr>
<td>8</td>
<td>Device management console Ethernet port</td>
<td>$\geq$ One (1)</td>
</tr>
<tr>
<td>9</td>
<td>Remote device Management and monitoring protocol support</td>
<td>(i) HTTPS Web Interface</td>
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<tr>
<td></td>
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<td>Microsoft AD, LDAP, RADIUS, Cisco pxGrid,</td>
</tr>
<tr>
<td>11</td>
<td>Redundancy</td>
<td>Active/Active and Active/Passive</td>
</tr>
<tr>
<td>12</td>
<td>Power supply unit type</td>
<td>Internal/external</td>
</tr>
<tr>
<td>13</td>
<td>Number of power supply units</td>
<td>Two (2)</td>
</tr>
<tr>
<td>14</td>
<td>Power supply units rating</td>
<td>$\geq 25W$</td>
</tr>
<tr>
<td>15</td>
<td>Power supply unit 1 input rating</td>
<td>$110 – 240V AC, 50Hz</td>
</tr>
<tr>
<td>16</td>
<td>Power supply unit 2 input rating</td>
<td>$110 – 220V DC</td>
</tr>
<tr>
<td>17</td>
<td>Enclosure type</td>
<td>Steel or metallic equivalent</td>
</tr>
<tr>
<td>18</td>
<td>Enclosure Protection as per IEC 60529</td>
<td>$\geq$ IP20</td>
</tr>
<tr>
<td>19</td>
<td>Mounting:</td>
<td>DIN or Rack type</td>
</tr>
<tr>
<td>20</td>
<td>Mounting accessories</td>
<td>Rack slide rails to be provided for rack mount option.</td>
</tr>
<tr>
<td>21</td>
<td>Continuous ambient operating temperature</td>
<td>$-5^\circ C$ to $+60^\circ C$</td>
</tr>
<tr>
<td>22</td>
<td>Operating Relative Humidity (non-condensing)</td>
<td>20 to 95%</td>
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<tr>
<td>23</td>
<td>Operating altitude without derating</td>
<td>$\geq 1000$ m</td>
</tr>
<tr>
<td>24</td>
<td>Manufacturer Warranty</td>
<td>$\geq$ 3 years</td>
</tr>
</tbody>
</table>
5.4.5.3 **Device Ruggedness**

(a) Immunity to EMI and heavy electrical surges  
   (i) Meets IEEE 1613 (electric utility substations)  
   (ii) Meets IEC 61850-3 (electric utility substations)

(b) Environmental withstand testing  
   (i) Meets IEEE 1613  
   (ii) Meets IEC 61850-3  
   (iii) Meets ETSI EN 300 019-2

(c) Fully independent 2kV (RMS) isolated ports

(d) -40°C to +75°C operating temperature (no fans)

(e) Contain no moving parts such as fans

(f) Galvanized steel enclosure at least 18 AWG thick

5.4.5.6 **Cyber security Management server**

5.4.5.6.1 **General requirements**

(a) Single point of managing all the cyber security gateways and performing functions such as  
   (i) Setting security policies for all the security appliances  
   (ii) Setting global policies on user access and data movement/access  
   (iii) Update of security appliance threat definitions and other software updates

(b) Security monitoring and management  
   (i) Real time monitoring of all security appliances health  
   (ii) Central monitoring/management of all alarms and events generated by the gateways.
   (iii) Generation of security alerts/notifications to operation and network administration personnel
   (iv) Allow creation and generation of security reports.
   (v) Allow analysis/audit of all security events in the network

(c) Allow Historizing of all security policies, logs, events and alarms in a central database

(d) Shall be installed as a virtual machine in the DMZ host server

5.4.5.6.2 **Minimum specifications**

(a) Fifty (50) Managed appliances/gateways

(b) Management of Network Policies
5.4.6 NETWORK MANAGEMENT SYSTEM

5.4.6.1 General Requirements

5.4.6.1.1 Contractor shall supply, install, configure and commission SolarWinds Network Management System.

5.4.6.1.2 Contractor shall deploy the SolarWinds Network Performance Monitor for management of the SCADA network infrastructure.

5.4.6.1.3 Contractor shall deploy the SolarWinds Server Application Manager to monitor the server architecture.

5.4.6.2 Scope of Works.

(a) Provision of SolarWinds Network Performance Monitor and SolarWinds Server Application Manager and software as detailed in clauses 5.2.10.4

(b) Installation, configuration and testing of the SolarWinds Network Management Systems prior to delivery.

(c) Commissioning of the SolarWinds Network Performance Monitor and SolarWinds Server Application Manager, after panel installation by the procuring entity, to monitor the SCADA network and the server infrastructure.

(d) In depth training on SolarWinds Network Management Systems as detailed in the proceeding clauses.

5.4.6.3 Technical Specifications Network Management Functions

5.4.6.3.1 SolarWinds Network Performance Monitor

(a) Quickly detect, diagnose, and resolve network performance issues and avoid downtime with network optimization software.

(b) View performance, traffic, and configuration details of devices and applications that are on-prem, in the cloud, or across hybrid environments with the NetPathTM feature.

(c) Accelerate identification of root cause by dragging and dropping network performance metrics on a common timeline for immediate visual correlation across all of your network data.
(d) Respond to multiple condition checks, correlated events, network topology, and device dependencies
(e) Automatically discover and map devices, performance metrics, link utilization, and wireless coverage.
(f) Automatically calculate exhaustion dates using customizable thresholds based on peak and average usage.
(g) Monitor logical components of the SDN environment, including APICs, tenants, application profiles, endpoint groups, and physical entities, with Cisco ACI support.
(h) Intuitive aggregation and visualization of data helps you get to root cause faster, even in complex environments.
(i) Dynamically calculate baseline thresholds from historical network performance data.
(j) Monitor, alert, and report on key device metrics, including temperature, fan speed, and power supply.
(k) Schedule and generate custom network performance reports with one of over 100 out-of-the-box templates.

5.4.6.3.2 Solar Winds Server Application Manager

(a) Monitor availability, response time, and hardware health of multi-vendor physical and virtual servers
(b) Track CPU, memory, and disk usage, and forecast when capacity will run out
(c) Remotely remediate server issues, including terminating runaway processes, starting/stopping services, rebooting servers, etc.
(d) Monitor server storage volumes, disk usage, and capacity metrics out of the box
(e) Integration with Solar Winds Storage Resource Monitor to provide deeper insight to help troubleshoot storage issues in SAN and NAS environments.
(f) Built-in Virtualization Monitoring
(g) physical servers, monitor health and availability of VMware® and Hyper-V® virtual hosts and guests
(h) Integration with Solar Winds Virtualization Manager to provide deeper insight to troubleshoot virtualization issues.
(i) Provide IT Asset Inventory Management
(j) Provide a centralized view of current hardware and software asset inventory to include server warranty status, driver software, hard drive inventory, and custom properties, such as PO number and purchase price.
(k) Correlated Alerts and Performance Reporting
(l) Get actionable information at the right time with advanced alerting, expert advice, and an easy-to-use web interface
(m) Provide access to over 100 web-based reports that are built to be ready to use, easy to customize, and can be shared immediately.

5.4.7 TRAINING

5.4.7.1 General Requirements

5.4.7.1.1 Contractor shall offer detailed training to the employer staff in order for them to be able to install, deploy and maintain the supplied equipment

5.4.7.1.2 The training shall be both theory and practical hands on to the procuring entity staff. The emphasis shall be on practical training which shall be conducted using the equipment in scope of supply

5.4.7.1.3 To ensure maximum knowledge transfer two or three procuring entity staff shall be attached to the contractor for the duration of the project from design to commissioning.

5.4.7.1.4 During commissioning, Contractor shall carry out all software, configurations, programming with the procuring entity engineers. They shall assign these tasks to the employer staff and supervise them to allow maximum knowledge transfer

5.4.7.1.5 The training shall be carried at the factory prior to FAT and at site after equipment delivery to site

5.4.7.1.6 All topics in the proceeding clauses and all other topics necessary for the procuring entity to install and deploy the supplied equipment shall be provided.

5.4.7.1.7 After project commencement the contractor shall prepare a detailed training program and syllabus and submit for approval as detailed in clause 5.1.7.4

5.4.7.1.8 Factory training shall be carried out for a minimum of five days to at least five procuring entity staff at each location that FAT shall be carried out

5.4.7.1.9 Site training shall be undertaken by a minimum of fifteen procuring entity staff for a minimum of the following duration
   (a) Hardware components minimum of five (5) days
(b) Software components minimum of ten (10) days
(c) Cyber security minimum of five (5) days
(d) Network management system minimum of three (3) days

The above training topics SHALL NOT be carried out concurrently and shall run one after the other to ensure procuring entity staff attend all the above sections.

5.4.7.1.10 Site training shall be carried out at procuring entity facilities two weeks after delivery of equipment to site or at a later date agreed upon during the kick off meeting.

5.4.7.1.11 Contractor will send to the client project engineer training aids, presentations and documents to be used for site training two weeks prior to the site training to ensure it covers the content of the approved training program.

5.4.7.1.12 By the end of the site training all topics in the proceeding clauses MUST be covered

5.4.7.1.13 Contractor shall provide certified and experienced trainers who are fluent and have excellent command of English language. Trainers not meeting this requirement shall be rejected and the contractor will re schedule the training with trainer meeting the requirements.

5.4.7.1.14 Contractor shall supply training aids including a detailed training guide or document well prepared in advance. Contractor is expected to be well prepared for the training with necessary presentations specific for the training.

5.4.7.1.15 Contractor will prepare and present certificates to participants at the end of the training

5.4.7.1.16 Contractor shall be wholly responsible for accommodation, transportation and any other required service by their personnel while offering training.

5.4.7.2 Hardware Components

5.4.7.2.1 The following basic training shall be offered for all the hardware devices (computers, switches, converters etc.) in scope of supply

(a) General Requirements: Install, Configure, Manage
   (i) Overview
   (ii) BIOS
   (iii) System Setup Utility
   (iv) Boot Manager

(b) Remote Access Controller (RAC)
   (i) Features and Functions
(ii)  Configuration
(iii)  Licensing
(iv)  RAC Web Interface
(v)  RAC Direct
(vi)  RAC Quick Sync
(c)  Lifecycle Controller
   (i)  Features and Functions
   (ii)  Accessing and Navigation
   (iii)  Updating
(d)  Lights out management
(e)  General device administration and Console configuration
(f)  Troubleshooting and routine maintenance
(g)  Assembly and installation
(h)  SNMP and syslog set up for network management
(i)  Drivers/firmware installation and upgrade
(j)  Download and upload of device setting files
(k)  Support Assist

5.4.7.2.2  The training shall be detailed enough to allow the procuring entity staff to install, configure and deploy any hardware equipment in scope of supply without the assistance of the supplier

5.4.7.2.3  Settings back up files shall be downloaded from the devices where applicable and handed over to the procuring entity

5.4.7.2.4  Training shall be practical and shall be conducted using the delivered equipment.

5.4.7.3  Software Components

5.4.7.3.1  Microsoft windows
   (a)  Microsoft Windows Server 2016 installation, basic set up and configuration
   (b)  Microsoft SQL Server installation, basic set up and configuration
   (c)  Microsoft storage Server installation, basic set up and configuration. NAS setup, deployment and configuration
   (d)  Management of Windows Workstations from Windows Server Domain Controller
   (e)  Creation and deployment of Windows Server Update Services (WSUS) Server and Approve and Deploy Updates to your Domain Servers and Computers
   (f)  Remote Desktop Services set up and deployment
(g) Active directory services set up and deployment
   (i) Creation of users, user groups and group policy management
   (ii) Building a domain

(h) Set up, configuration and deployment of DHCP and DNS

(i) Windows server security policies

(j) Windows services set up and administration

(k) Windows server power shell scripts

(l) Licensing and Renewals

5.4.7.3.2 Virtualization

(a) Introduction to vSphere & the software-defined data centre

(b) VMware vSphere: Install, Configure, Manage
   (i) Vsphere hypervisor
   (ii) virtual machines
   (iii) vCenter server
   (iv) Vmotion
   (v) vSphere client functions and usage
   (vi) vSphere HA & vSphere fault tolerance
   (vii) vSphere drs
   (viii) vSphere update manager

(c) vSphere troubleshooting

(d) Configuring & managing virtual networks

(e) Configuring & managing virtual storage

(f) Allocating and administering virtual resources (CPU, RAM, NIC etc.)

(g) Setting up virtual machine manual and automatic backups.

(h) Resource management & monitoring

(i) Best practices for long term virtualised infrastructure administration

(j) Seamless hardware replacement in virtualised environments

5.4.7.4 Cybersecurity

5.4.7.4.1 Security Gateway

(a) Introduction to Firewalls: Security review, what is a firewall? What do firewalls do? Firewall benefits, concepts.

(b) Firewall Configuration: Firewall types, Packet filtering, SPI, Proxy, Personal. Software firewalls, hardware firewalls, blade-based firewalls, personal firewalls, which firewall should you use? Firewall products.
(c) Configuring packet filtering firewalls: Things to filter in the IP header, stateless vs. stateful filtering. ACLs. Advantages of packet filtering.

(d) Stateful packet inspection firewalls: Stateful algorithms, packet by packet inspection, application content filtering, tracks, special handling (fragments, IP options), sessions with TCP and UDP. Firewall hacking detection: SYN attacks, SSL, SSH interception.

(e) Proxy firewalls: Circuit level, application level, SOCKS. Proxy firewall advantages and disadvantages.

(f) Resilient firewall architecture: Firewall architectures: Home based, small office, enterprise, service provider, what is a DMZ? DMZ architectures, bastion hosts, multi DMZ. Virtual firewalls, transparent firewalls. Dual firewall design, high availability, load balancing, VRRP.

(g) Securing communications: VPNs, IPsec. Firewall configuration of VPNs, integration of dedicated VPN devices and firewalls.

(h) Testing firewalls: Configuration checklist, testing procedure, monitoring firewalls, logging, and syslog.

(i) Sandblast Zero-Day Protection.

5.4.7.4.2 Industrial Control System (ICS) and SCADA Cybersecurity Should cover a variety of topics in ICS and SCADA cybersecurity such as:

(a) Fundamentals of ICS and SCADA cyber security
(b) Application control for SCADA/ICS applications
(c) ICS and SCADA vulnerabilities,
(d) Risk management basics,
(e) Selecting and implementing controls for ICS security,
(f) ICS/SCADA network and device security,
(g) SCADA security program development, and wireless security applied to SCADA systems.

5.4.7.4.3 All in One Security Management Solution

(a) Policy Management
(i) Implementing the Rule Base
(ii) To Verify and View the QoS Policy
(iii) To Install and Enforce the Policy
(iv) To Uninstall the QoS Policy
(v) To Monitor the QoS Policy

(b) Integrated Threat Management
(i) Real Time Integrated Threat Monitoring
(ii) deep forensic analysis
(iii) integrated logging events
(iv) governance and compliance
(v) Full visibility and control across your Network.

(c) Data Storage and Performance
(i) Manage thousands of simultaneous sources
(ii) Manage thousands of rules and millions of transactions with up to 8x the data storage and performance on a single machine.
(iii) Manage modular platform supporting up to 24 cores, 256GB RAM and 48TB of storage for any deployment environment

5.4.7.5 **Network Management System**

5.4.7.5.1 Contractor shall offer detailed training to the employer staff for them to be able to

(a) Deploy the Orion Platform
(b) Configure Orion Views, Maps & Accounts
(c) Configure Orion Alerts & Reports
(d) Getting Started with Server & Application Monitoring
(e) Building & Implementing Custom Application Templates
(f) APM 1.0 for Server & Application Monitor (SAM) Users
(g) Introduction to Server & Application Monitor
(h) New Feature Training: SAM 6.7 and Log Manager for Orion 1.1
(i) Installing NPM
(j) How to Install an Additional Polling Engine
(k) How to Set up High Availability
(l) Migrating your Orion Platform Product to Another Server
(m) Upgrading NPM
(n) Adding a New Alert
(o) Reducing Alert Noise
(p) Understanding Trigger Condition Logic
(q) Configuring Advanced Alert Options
(r) Understanding Reset Condition Logic
(s) Creating a New View
(t) Adding and Customizing Resources
(u) Create Network Atlas Maps
(v) Adding View limitations
(w) Create a NOC View
5.4.8 COMMISSIONING SUPPORT

5.4.8.1 General Requirements

5.4.8.1.1 After the delivery of equipment to all sites and site training is conducted the procuring entity shall install the supplied panels and loose items in the power plants. Procuring entity shall carry out: panel installation, all external cable connections, carry out basic tests and install/deploy SCADA applications.

5.4.8.1.2 After installation of the equipment (by the procuring entity) the procuring entity shall invite the contractor to come and support the procuring entity during commissioning and deployment of the equipment/systems.

5.4.8.1.3 Commissioning support shall be for services offered by contractors’ personnel physically present at site and not online support.

5.4.8.1.4 Contractor shall be wholly responsible for accommodation, transportation and any other required service by their personnel while offering commissioning support. Procuring entity shall not offer accommodation to contractor staff in seven forks, there are good hotels near seven forks plants.

5.4.8.2 Scope of Commissioning support

5.4.8.2.1 Contractor shall offer the following services during commissioning:

(a) Modifying device & software settings to suite the procuring entity SCADA applications and users.
(b) Carry out any necessary configurations in the servers, Ethernet switches, industrial PC’s, virtual machines etc. necessary for optimal SCADA system operation.
(c) Carry out any necessary pending hardware configurations necessary for final commissioning.
(d) Test the configured settings and services and optimise them for best security, performance and reliability.
(e) Deployment and commissioning of NMS and cyber security functions as detailed in particular specification.

5.4.8.2.2 Commissioning support for supplied equipment except NMS & cyber security shall be carried out after installation in the first power plant. The contractor shall send experienced personnel conversant with equipment to site support the procuring entity personnel during commissioning as follows.
(a) Minimum of five working days for Kamburu RCC (servers & related infrastructure) commissioning
(b) Minimum of three working days for LCC equipment (industrial grade equipment) in one station in the seven forks area.

5.4.8.2.3 Commissioning support for network management system & cyber security shall be carried as follows:

(a) Shall be carried out after installation of equipment at the last power plant. NMS and cyber security services will remain inactive until all the equipment in all the power plants have been commissioned and have been operational at least for one week.

(b) These services shall be configured and deployed by the contractor in conjunction with the procuring entity personnel as detailed in the particular specifications.

(c) Contractor shall provide experienced and qualified personnel for these functions. Contractor personnel sent MUST have at least five years’ experience and shall have all the necessary certification from solution provider

(d) The duration of these services shall be set out by the contractor, however enough time shall be allocated for these works. At minimum contractor personnel shall be at site for seven working days to deploy these services

5.4.8.2.4 The contractor shall send personnel for further support after the initial commissioning support for a maximum of thirty expert man days (ten days for three experts or thirty days for a single expert or equivalent) if called upon to do so by the procuring entity. The support shall be to any station within seven forks or Kamburu RCC. The days shall not necessarily be concurrent and will depend on procuring entity needs. The bidder shall cost at least thirty expert man days for extra support. The procuring entity may ask assistance for a single day or more than a day for a single expert or more than one expert.

5.4.8.2.5 Contractor shall as much as possible engage local/Kenyan personnel or personnel based in Kenya to provide the commissioning support. International firms shall as much as possible subcontract these services to local companies which meet qualification requirements.

5.4.8.2.6 After contract commencement contractor shall send CV’s and copies of certifications of personnel and their alternates proposed to offer commissioning support.

5.4.8.2.7 Procuring entity shall only accept contractors’ personnel who meet the minimum requirements given in clause below to offer services.
5.4.8.3 Personnel Qualifications

Personnel engaged by the contractor to provide commissioning support shall meet the following.

5.4.8.3.1 A minimum bachelor’s degree or advanced diploma in a related field of study

5.4.8.3.2 Shall be fluent and have excellent command of spoken and written English language.

5.4.8.3.3 Shall have a minimum of five years’ experience since graduation.

5.4.8.3.4 Shall have a minimum of five years’ experience carrying out design, installation, deployment and commissioning of equipment/systems similar to the ones in scope of supply

5.4.8.3.5 Shall have worked with the equipment/system model/manufacturer supplied by the contractor for at least one year or in at least two previous projects.

5.4.8.3.6 For software systems support the personnel MUST have a minimum of the following valid certification:

(a) Microsoft Certified Solutions Expert (MCSE): Core Infrastructure for windows server support

(b) Cisco Certified Network Professional (CCNP) for Cisco devices support

(c) VMware Certified Professional (VCP) for VMware virtualisation support

(d) Certified Information Systems Security Professional (CISSP) or equivalent from the cyber security solution provider (eg KL Certified Systems Engineer, Check Point Certified Expert (CCSE), CCNA Cyber Ops, Fortinet Network Security Expert 8, etc.) for cyber security solutions.

(e) Solar Winds Certified Professional (SCP) for network management system support

5.4.9 TOOLS & ACCESSORIES

5.4.9.1 Engineering Laptops

5.4.9.1.1 At least FOUR portable computers (laptops) shall be supplied for the project.

5.4.9.1.2 Laptops shall be delivered with all software and licences specified in the scope of supply

5.4.9.1.3 Laptop shall be strong and durable and shall meet US military MIL-STD-810G standards for reliability and performance under extreme conditions, namely
temperature, altitude, humidity, dust, shock and vibration. The Laptops shall feature a magnesium alloy chassis, anodized aluminium lid and palm rests and spill-resistant keyboards.

5.4.9.1.4 Each laptop shall have at minimum the following specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ruggedness</td>
<td>Tested as per MIL-STD-810G and passed the following tests:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Drop test in accordance with MIL-STD-810G, Method 516.6 Procedure IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Shock test in accordance with MIL-STD-810G, Method 516.6 Procedure I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Vibration Resistance test in accordance with MIL-STD-810G, Test Method 514.6 Procedure I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Dust Resistance in accordance with MIL-STD-810G, Method 510.5, Procedure I (Dust)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Humidity test in accordance with MIL-STD-810G, Method 507.5, Procedure II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Altitude test in accordance with MIL-STD-810G, Method 500.5, Procedure I (Storage) and II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- High Temperature test in accordance with MIL-STD-810G, Method 501.5, Procedure I (Storage) and II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sand test in accordance with MIL-STD-810G, Method 510.4 Procedure II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- bench handling test in accordance to the MIL-STD-810G, Method 516.6 Procedure VI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Crash hazard test in accordance to the MIL-STD-810G, Method 516.5 Procedure V</td>
</tr>
</tbody>
</table>

**NB** Workstation enterprise grade laptop computers such as HP ZBook G4, G5 series etc. have been tested and
<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Processor type</td>
<td>Intel® Core™ i7 or i9 eighth or ninth generation series</td>
</tr>
<tr>
<td>3</td>
<td>No of processor cores</td>
<td>≥ 4 cores and ≥8 threads</td>
</tr>
<tr>
<td>4</td>
<td>Processor base frequency</td>
<td>≥2.80GHz</td>
</tr>
<tr>
<td>5</td>
<td>Processor L3 cache</td>
<td>≥6MB</td>
</tr>
<tr>
<td>6</td>
<td>Memory bus speed</td>
<td>≥2400Mhz</td>
</tr>
<tr>
<td>7</td>
<td>Installed RAM type</td>
<td>≥DDR4-2400</td>
</tr>
<tr>
<td>8</td>
<td>Installed RAM size</td>
<td>≥16GB</td>
</tr>
<tr>
<td>9</td>
<td>GPU core speed</td>
<td>≥1100MHz</td>
</tr>
<tr>
<td>10</td>
<td>GPU Memory</td>
<td>≥4GB</td>
</tr>
<tr>
<td>11</td>
<td>GPU memory speed</td>
<td>≥5000 MHz</td>
</tr>
<tr>
<td>12</td>
<td>Solid state drive</td>
<td>≥512 GB, M.2 NVMe MLC Solid State Drive (No hard disk allowed)</td>
</tr>
<tr>
<td>13</td>
<td>Optical Drive:</td>
<td>DVD+/-RW Super Multi DL - external drive via USB 3.0</td>
</tr>
<tr>
<td>14</td>
<td>OEM pre-installed Operating Systems</td>
<td>Latest 64bit Windows (windows10 or higher) professional edition with perpetual licence</td>
</tr>
<tr>
<td>15</td>
<td>Display Type</td>
<td>LED Full High Definition</td>
</tr>
<tr>
<td>16</td>
<td>Display size</td>
<td>17.3inch diagonal</td>
</tr>
<tr>
<td>17</td>
<td>Display Resolution</td>
<td>≥1920x1080</td>
</tr>
<tr>
<td>18</td>
<td>Camera and Microphone</td>
<td>≥720p HD Webcam</td>
</tr>
<tr>
<td>19</td>
<td>Integrated Communications</td>
<td>Integrated Gigabit ethernet Network Controller</td>
</tr>
<tr>
<td>20</td>
<td>Integrated Wireless</td>
<td>802.11 AC/a/b/g/n (2x2) WiFi + Bluetooth® 4.2</td>
</tr>
<tr>
<td>21</td>
<td>Integrated Security</td>
<td>Security Lock Slot plus steel cable (5.5mm thick) with a combination lock</td>
</tr>
<tr>
<td>22</td>
<td>USB Interfaces</td>
<td>Two (2) USB 3.0 Type A and Two (2) USB 3.0 Type C thunderbolt</td>
</tr>
<tr>
<td>23</td>
<td>Video ports</td>
<td>One (1) HDMI &amp; One (1) Display port 1.4</td>
</tr>
</tbody>
</table>
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Audio</td>
<td>stereo microphone in 1 stereo headphone/line-out</td>
</tr>
<tr>
<td>25</td>
<td>Gigabit Ethernet port</td>
<td>≥ one (1) RJ-45</td>
</tr>
<tr>
<td>26</td>
<td>Connectors</td>
<td>docking connector power &amp; secondary battery connector</td>
</tr>
<tr>
<td>27</td>
<td>Pointing Devices</td>
<td>Touchpad with on/off button, two-way scroll, gestures, two pick buttons</td>
</tr>
<tr>
<td>28</td>
<td>Keyboard</td>
<td>Full-size, spill resistant keyboard with drains</td>
</tr>
<tr>
<td>29</td>
<td>Mouse</td>
<td>optical wireless mouse</td>
</tr>
<tr>
<td>30</td>
<td>Battery</td>
<td>≥ 90 WHr Li-Ion</td>
</tr>
<tr>
<td>31</td>
<td>Power Supply</td>
<td>240V AC, 50Hz with a C13 to 3pin British type connector cord.</td>
</tr>
<tr>
<td>32</td>
<td>Carrying Case</td>
<td>Genuine Leather Carrying Case</td>
</tr>
<tr>
<td>33</td>
<td>Manufacturer Warranty</td>
<td>≥ 3 years</td>
</tr>
</tbody>
</table>

5.4.9.2 Ultra short distance projectors for wall mounting

5.4.9.2.1 Three (3) Epson EB-685Wi or equivalent Ultra short distance projectors for wall mounting shall be supplied for the project.

5.4.9.2.2 Each Projector shall have at minimum the following specifications and accessories

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Projection System</td>
<td>3LCD, 3-chip technology</td>
</tr>
<tr>
<td>2</td>
<td>Projection Method</td>
<td>wall mount, ultra-short distance</td>
</tr>
<tr>
<td>3</td>
<td>Driving Method</td>
<td>Poly-silicon TFT Active Matrix</td>
</tr>
<tr>
<td>4</td>
<td>Pixel Number</td>
<td>1,024,000 dots (1280 x 800) x 3</td>
</tr>
<tr>
<td>5</td>
<td>Color &amp; White brightness</td>
<td>3300 lumens</td>
</tr>
<tr>
<td>6</td>
<td>Interactive (Color &amp; White)</td>
<td>3300 lumens</td>
</tr>
<tr>
<td>7</td>
<td>Aspect Ratio</td>
<td>16:10</td>
</tr>
<tr>
<td>8</td>
<td>Native resolution</td>
<td>1280 x 800 (WXGA)</td>
</tr>
<tr>
<td>9</td>
<td>Lamp Life</td>
<td>10,000 hours.</td>
</tr>
<tr>
<td>10</td>
<td>Throw ratio</td>
<td>0.27 – 0.44</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Size (projected distance)</td>
<td>60 - 100”</td>
</tr>
<tr>
<td>12</td>
<td>USB Plug ‘n Play</td>
<td>Windows &amp; Mac OS</td>
</tr>
<tr>
<td>13</td>
<td>Contract Ratio</td>
<td>16,000 : 1</td>
</tr>
<tr>
<td>14</td>
<td>Color Reproduction Color</td>
<td>Upto 1.07 billion colors.</td>
</tr>
<tr>
<td>15</td>
<td>Colour Processing</td>
<td>10 bit</td>
</tr>
<tr>
<td>16</td>
<td>Projection lens</td>
<td>Manual focus, f-num = 1.6, f.length = 6.4 mm, Digital zoom = 1.0 – 1.35x</td>
</tr>
<tr>
<td>17</td>
<td>Interfaces</td>
<td>USB 2.0 Type A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USB 2.0 Type B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wireless LAN IEEE 802.11b/g/n (WiFi)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two (2) VGA inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA out</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three (3) HDMI inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stereo mini jack audio out, Stereo mini jack audio in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Composite in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MHL input</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB in (2x), RGB out</td>
</tr>
<tr>
<td>18</td>
<td>Speakers</td>
<td>Inbuilt 16 W Mono</td>
</tr>
<tr>
<td>19</td>
<td>Wireless projection</td>
<td>Required.</td>
</tr>
<tr>
<td>20</td>
<td>Operating temperature</td>
<td>5 – 35 degree Celsius</td>
</tr>
<tr>
<td>21</td>
<td>Power Supply Voltage</td>
<td>100 – 240V ±10%, 50 / 60Hz</td>
</tr>
<tr>
<td>23</td>
<td>Interactive Input device</td>
<td>Dual interactive pen with mouse capabilities, and led pointing (with rechargeable batteries)</td>
</tr>
<tr>
<td>24</td>
<td>Calibration method</td>
<td>Automatic</td>
</tr>
<tr>
<td>25</td>
<td>Weight</td>
<td>&lt;4 kg</td>
</tr>
<tr>
<td>26</td>
<td>Security</td>
<td>Should come with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Kensington lock.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Security anchor bar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Password protection function.</td>
</tr>
<tr>
<td>27</td>
<td>Interactive software and drivers.</td>
<td>To be supplied</td>
</tr>
</tbody>
</table>
5.4.9.3 **Short distance desktop projector**

5.4.9.3.1 **Two (2)** Epson EB-536Wi or equivalent Short distance desktop projectors shall be supplied for the project.

5.4.9.3.2 Each Projector shall have at minimum the following specifications and accessories

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Projection System</td>
<td>3LCD, 3-chip technology</td>
</tr>
<tr>
<td>2.</td>
<td>Projection Method</td>
<td>short distance, desktop or ceiling mount</td>
</tr>
<tr>
<td>3.</td>
<td>Driving Method</td>
<td>Poly-silicon TFT Active Matrix</td>
</tr>
<tr>
<td>4.</td>
<td>Pixel Number</td>
<td>1,024,000 dots (1280 x 800) x 3</td>
</tr>
<tr>
<td>5.</td>
<td>Color &amp; White brightness</td>
<td>3400 lumens</td>
</tr>
<tr>
<td>6.</td>
<td>Interactive (Color &amp; White)</td>
<td>3400 lumens</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7.</td>
<td>Aspect Ratio</td>
<td>16:10</td>
</tr>
<tr>
<td>8.</td>
<td>Native resolution</td>
<td>1280 x 800 (WXGA)</td>
</tr>
<tr>
<td>9.</td>
<td>Lamp Life</td>
<td>10,000 hours.</td>
</tr>
<tr>
<td>10.</td>
<td>Throw ratio</td>
<td>0.27 – 0.44</td>
</tr>
<tr>
<td>11.</td>
<td>Size (projected distance)</td>
<td>53 - 116”</td>
</tr>
<tr>
<td>12.</td>
<td>USB Plug ‘n Play</td>
<td>Windows &amp; Mac OS</td>
</tr>
<tr>
<td>13.</td>
<td>Contract Ratio</td>
<td>16,000 : 1</td>
</tr>
<tr>
<td>15.</td>
<td>Colour Processing</td>
<td>10 bit</td>
</tr>
<tr>
<td>16.</td>
<td>Projection lens</td>
<td>Manual focus, f-num = 1.6, f.length = 6.4 mm, Digital zoom = 1.0 – 1.35x</td>
</tr>
<tr>
<td>17.</td>
<td>Interfaces</td>
<td>USB 2.0 Type A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USB 2.0 Type B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wireless LAN IEEE 802.11b/g/n (WiFi 4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two (2) VGA inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA out</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three (3) HDMI inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stereo mini jack audio out, Stereo mini jack audio in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Composite in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MHL input</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB in (2x), RGB out</td>
</tr>
<tr>
<td>18.</td>
<td>Speakers</td>
<td>Inbuilt 16 W Mono</td>
</tr>
<tr>
<td>20.</td>
<td>Operating temperature</td>
<td>5 – 35 degree Celsius</td>
</tr>
<tr>
<td>21.</td>
<td>Power Supply Voltage</td>
<td>100 – 240V ±10%, 50 / 60Hz</td>
</tr>
<tr>
<td>23.</td>
<td>Interactive Input device</td>
<td>Dual interactive pen with mouse capabilities, and led pointing (with rechargeable batteries)</td>
</tr>
<tr>
<td>24.</td>
<td>Calibration method</td>
<td>Automatic</td>
</tr>
<tr>
<td>25.</td>
<td>Weight</td>
<td>&lt;4 kg</td>
</tr>
<tr>
<td>26.</td>
<td>Security</td>
<td>Should come with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Kensington lock.</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Requirements</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security anchor bar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Password protection function.</td>
</tr>
<tr>
<td>27</td>
<td>Interactive software and drivers.</td>
<td>To be supplied</td>
</tr>
<tr>
<td>28</td>
<td>Accessories</td>
<td>All the accessories below to be supplied for each projector:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(i) One extra spare interactive pen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) Document camera with USB &amp; HDMI ports, 12x optical zoom,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10x digital zoom, 30 fps, 1080p, 2MP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Quick wireless USB key</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iv) Soft carry case</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(v) Wireless LAN unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(vi) Remote control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(vii) Two (2) 5m HDMI cables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(viii) Two (2) 5m VGA cables</td>
</tr>
<tr>
<td>29</td>
<td>Manufacturer Warranty</td>
<td>≥ 2 years</td>
</tr>
</tbody>
</table>

5.4.10 INSPECTION AND TESTING

All components and panel/cabinet assemblies shall be tested in accordance with the relevant IEC and IEEE Standards to verify compliance with the requirements of the Standards and this specification.

5.4.10.1 Type Test

5.4.10.1.1 Type test Reports/certificate Requirements

(a) Type tests shall be certified by an EU/USA/Canadian National Standards and Testing Authority (NSTA) or by a third-party Reputable Testing Authority accredited by an EU/USA/Canadian National Standards and Testing Authority (NSTA).

(b) Where a body other than NSTA stated above is used to certify the type-test reports, a copy of the certificate of accreditation shall be attached.
(c) Results of type test shall have been conducted at least 6 months and not more than fifteen years prior to the date of tender submission. The contractor shall submit contact details (Title, email, and fax) of certifying laboratory during design.

(d) Testing materials and equipment in Type Test Reports shall have the same code/ country / manufacturer and technical parameters as offered materials and equipment. Type tests of non-conforming materials/equipment shall not be accepted.

(e) Type Test Reports shall include all items tested and results confirming that they meet the requirements of applied standards as stipulated in Tender Documents.

(f) Type Test reports shall have Report Numbers for authentication.

(g) Current contact information of the testing and certification authority shall be provided during design.

5.4.10.1.2 Product certifications approved through testing by from the following bodies will be accepted: UL, CE, FCC, RoHS, TUV GS where stated

5.4.10.1.3 Type test reports and product certificates shall be provided during design or at bidding stage in accordance as detailed in the tender.

5.4.10.2 Factory Acceptance Tests

5.4.10.2.1 General Requirements

(a) Tests given in this clause are not comprehensive and only highlight the minimum required tests. The contractor shall prepare detailed test plans as per clause 5.1.8.3.3, covering all detailed tests necessary as per requirements of IEC 60255, IEC61850, IEEE C37.90 and IEEE 1613 and any other stated standard.

(b) The procuring entity personnel shall witness the factory tests in person.

(c) All cubicles shall be subject to inspection during manufacture and on completion to verify compliance with all the requirements of the Specification, including surface finish and insulation resistance.

(d) FAT witnessed by procuring entity for Industrial PC’s, industrial ethernet switches and the industrial time server shall be carried out at the factory where these devices are manufactured.

(e) Enterprise grade servers and other equipment shall be tested at the point of cubicle assembly.
(f) All items to be supplied loose (not mounted in a cubicle/panel) e.g. operator workstation components, PLC panel components, tools & accessories and spares shall be tested at the factory or contractors’ premises (except devices named in clause (d)) prior to shipping to the site. Acceptance tests shall not be carried out site

(g) All equipment in scope of supply shall be subject to testing and inspection prior to delivery to site

5.4.10.2.2 General Tests

(a) These tests shall be carried out on all equipment in scope of supply

(b) Visual Checks: General Check of the panels/cabinets in respect of dimension, finishing, construction, wiring & ferules verification lay out equipment on the panel, make and rating of instrument etc.

(c) Operational tests: Operation tests on all equipment to prove correctness of wiring of various circuits as per the approved design

(d) Setting range and Functional tests

(e) Power on checks

(f) Insulation/dielectric tests

(g) Network/communication checks

(h) For moving parts e.g. slide rails, a minimum of ten consecutive mechanical operations shall be carried out in quick succession to confirm the healthiness of the cubicle assembly

5.4.10.2.3 Tests on Industrial Grade Equipment

(a) The following industrial grade components will be subjected to a 48-hour burn-in factory test at the factory of manufacture

   (i) Industrial PC

   (ii) Industrial Ethernet switches

   (iii) Industrial clock & time server

(b) Devices to be subjected to burn in tests shall be sampled by the procuring entity personnel

(c) During the test the components will be operated at maximum workload (by simulation where necessary) and at 40°C temperature (to be monitored during the test), and the components will be monitored during the test to confirm they are functioning normally.

(d) If components operation will not be monitored continuously during the burn-in test, then:
(i) the interval between monitoring periods will be short enough that the probability of a component mis-operation during non-monitored periods is insignificant; and

(ii) the burn-in test Procedure will illustrate how the interval between monitoring periods is selected, and how the probability of component mis-operation during non-monitored periods is insignificant.

(iii) If abnormal operation is observed during the burn-in test, then the test will be considered a failure

(e) The burn in tests shall not be type tests and shall hence not be destructive, neither shall they reduce the life of the component tested. Tests shall be conducted at an industrial environment or simulated industrial environment with heightened temperatures >35°C which are usual at the point of installation of these devices

(f) A detailed Procedure for burn-in testing shall be provided as per clause 5.1.8.3.3 of specifications.

(g) LCC panel and components Insulation Resistance tests shall be carried out as per IEC 60255 standards

(h) LCC panel and components Dielectric strength tests shall be carried out as per relevant IEC60255 standards

(i) Other relevant routine tests shall be carried out in accordance to IEC 60255, IEC61850, IEEE C37.90 and IEEE 1613
SECTION VI: SCHEDULE OF REQUIREMENTS

See APPENDIX I attached for:

TECHNICAL SCHEDULES

PRELIMINARY BILL OF MATERIALS
BILL OF QUANTITIES
SECTION VII: PRICE SCHEDULE

PREAMBLE

1. The bill of quantities does not generally give a full description of the equipment to be supplied and the services to be performed under each item. Bidders shall be deemed to have read the specifications and other sections of the Bidding Document to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices. The entered rates and prices shall be deemed to cover the full scope as aforesaid, including overheads and profit.

2. If bidders are unclear or uncertain as to the scope of any item, they shall seek clarification as per ITT 2.5 prior to submitting their bid.

3. Prices shall be filled in indelible ink, and any alterations necessary due to errors, etc., shall be initialled by the Bidder.

4. As specified in the Special Conditions of Contract, prices shall be fixed and firm for the duration of the Contract.

5. Bid prices shall be quoted in the manner indicated and, in the currencies, specified in the Instructions to Bidders in the Bidding Document.

6. Prices given in the Schedules against each item shall be for the scope covered by that item as detailed elsewhere in the Bidding Document.

7. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.

8. When requested by the Employer for the purposes of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedules.

9. All the Bill of quantities entries MUST be filled failure to which the bid offer shall be rendered unresponsive.

10. The offered unit price shall be rounded to two decimal places.

11. The total prices for goods shall be DDP as per Incoterms 2010 to seven forks power plants and Turkwel.

12. Bidder shall include in their costs (whether indicated on the BQ or not) the withholding taxes which shall be retained by the employer as per Kenyan tax laws. Bidders shall familiarise themselves with all the applicable laws before filling the bid.
## OVERALL BILL OF QUANTITIES

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## Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

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Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

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**SUB TOTAL KINDARUMA OPERATOR WORKSTATION TERMINALS**

| 4  | **Kindaruma PLC panel components**                                         |                   |       |          |                       |                      |
| 4.1| Touch screen Industrial panel PC                                           |                   | units | 4        |                       |                      |
| 4.2| Digital Energy & Power Meter                                               |                   | units | 6        |                       |                      |

**SUB TOTAL KINDARUMA PLC PANEL COMPONENTS**

**SUB TOTAL KINDARUMA SCOPE**

| D  | **GITARU SCOPE** Delivered to Gitaru Power station control room            |                   |       |          |                       |                      |
|    | **Gitaru Local Control Centre (LCC) panels**                               |                   |       |          |                       |                      |
| 1  | Complete panel with panel parts and panel accessories as detailed in specifications. |                   | units | 1        |                       |                      |
| 1.2| Rack mount Industrial Ethernet switches                                     |                   | units | 4        |                       |                      |
| 1.3| Rack mount industrial computers with all specified licensed software as per specifications |                   | units | 2        |                       |                      |
| 1.4| Rack mount PTP Grandmaster clock & Time server with integrated GNSS receiver |                   | units | 1        |                       |                      |
| 1.5| DCF77 Time code output converter                                            |                   | units | 1        |                       |                      |
| 1.6| Industrial security Appliances                                              |                   | units | 4        |                       |                      |
| 1.7| 19” industrial grade Touch monitor                                         |                   | units | 1        |                       |                      |
| 1.8| Manager Thin Client PC’s                                                    |                   | units | 1        |                       |                      |
| 1.9| Four port KVM switch                                                       |                   | units | 1        |                       |                      |
| 1.10| Networking accessories (Total as detailed in the Bill of Materials)        |                   | lot   | 1        |                       |                      |
| 1.11| Electrical accessories (Total as detailed in the Bill of Materials)        |                   | lot   | 1        |                       |                      |

**SUB TOTAL GITARU LCC PANEL**

<p>| 2  | <strong>Gitaru process LAN panels</strong>                                              |                   |       |          |                       |                      |
|    | Complete panel with panel parts and panel accessories as detailed in specifications. |                   | units | 1        |                       |                      |
| 2.2| Rack mount Industrial Ethernet switches                                     |                   | units | 2        |                       |                      |</p>
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Bidders seal or stamp

Price Schedule

January 2020
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<td></td>
</tr>
<tr>
<td>3.5</td>
<td><strong>SUB TOTAL TURKWELE PROCESS LAN PANEL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Turkwel PLC panel components</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Touch screen Industrial panel PC</td>
<td></td>
<td>units</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Digital Energy &amp; Power Meter</td>
<td></td>
<td>units</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td><strong>SUB TOTAL TURKWELE PLC PANEL COMPONENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>SUB TOTAL TURKWELE SCOPE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>TOOLS &amp; ACCESSORIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Engineering Laptops with preinstalled software &amp; accessories</td>
<td></td>
<td>units</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Network cable repair maintenance toolkit</td>
<td></td>
<td>lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cat7, RJ45-RJ45, 3 meters, Shielded Twisted pair patch cords</td>
<td></td>
<td>units</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Single mode duplex LC-LC connector Fibre optic patch cords</td>
<td></td>
<td>units</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Outdoor SSTP Cat 7 cable rolls (300m)</td>
<td></td>
<td>Rolls</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Indoor SSTP Cat 7 cable rolls (300m)</td>
<td></td>
<td>Rolls</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4X4mm sq. SWA Cable with coloured cores, brown, black, grey and blue-standard IEC AC phases colours</td>
<td></td>
<td>meters</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Description</td>
<td>Country of Origin</td>
<td>UoM</td>
<td>Quantity</td>
<td>Unit Price (currency)</td>
<td>TOTAL DDP (currency)</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
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<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>8</td>
<td>19X1.5mm sq. SWA Cable with numbered cores (1-19 sequentially) for controls</td>
<td></td>
<td></td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Ultra short distance projectors for wall mounting</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Short distance desktop projectors.</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SUB TOTAL TOOLS &amp; ACCESSORIES SCOPE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td><strong>SPARES Delivered to Gitaru power Station Store</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Rack mount Industrial Ethernet switches</td>
<td>units</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Rack mount industrial computers with all specified licensed software as per specifications</td>
<td>units</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Rack mount PTP Grandmaster clock/ Time server with integrated GPS receiver</td>
<td>units</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Industrial security Appliance</td>
<td>units</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Thin Client computers</td>
<td>units</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 Rack mount VM Host Servers complete with licensed pre-installed software</td>
<td>units</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 Rack mount Sixteen Outlet (C13),240 V AC,32A PDU</td>
<td>units</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 27.0 Inch LED/LCD monitor</td>
<td>units</td>
<td></td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td>9 DCF77 Time code output converter</td>
<td>units</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 Touch screen Industrial panel PC</td>
<td>units</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
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<td><strong>SUB TOTAL SPARES SCOPE</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I</td>
<td><strong>SERVICES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Software Services (does not include software with perpetual licences pre-installed into the hardware)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1 VMware Essential plus Software basic support</td>
<td>Years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 Enterprise security Appliances with all specified features Software basic support and specified subscription licenses</td>
<td>years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3 Industrial grade security Appliances with all specified features Software basic support and specified subscription licenses</td>
<td>years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.4 Security management server with all specified features Software basic support and specified subscription licenses</td>
<td>years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5 Solar Winds Orion Network Performance monitoring Software basic support</td>
<td>Years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.6 Solar Winds Server &amp; Application Monitor (SAM) Software basic support</td>
<td>years</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Country of Origin</td>
<td>UoM</td>
<td>Quantity</td>
<td>Unit Price ($currency)</td>
<td>TOTAL DDP ($currency)</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>------</td>
<td>----------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>1.7</td>
<td>CISCO SmartNET licenses for three (3) year Support</td>
<td></td>
<td>sets of License</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>Any Other subscription software licences in scope of supply (bidder to itemise)</td>
<td></td>
<td>Years</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td>All Licensed Software delivered loose i.e. not installed in any hardware (bidder to itemise)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>Other (bidder to itemise)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SUB TOTAL SOFTWARE SERVICES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Other services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Cabinet/panel assembly, device mounting, device configuration, device software set up, device Labelling, internal cabling &amp; wiring, factory testing etc. And all services required for development of complete panels/cabinets</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Factory Acceptance testing and training as detailed in tender</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Technical documentation as detailed in tender</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Site training as detailed in tender</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Commissioning Support as detailed in tender</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Online support as detailed in tender scope of supply</td>
<td></td>
<td>Lot</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SUB TOTAL OTHER SERVICES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SUB TOTAL SERVICES SCOPE</strong></td>
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<td></td>
<td></td>
<td></td>
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</table>
### SUMMARY BILL OF QUANTITIES

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>TOTAL (currency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>GOODS</td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Kamburu Scope of supply, DDP Kamburu power station</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Kiambere Scope of supply, DDP Kiambere power station</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Kindaruma Scope of supply, DDP Kindaruma power station</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Gitaru Scope of supply, DDP Gitaru power station</td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>Masinga Scope of supply, DDP Masinga power station</td>
<td></td>
</tr>
<tr>
<td>A6</td>
<td>Turkwel Scope of supply, DDP Turkwel power station</td>
<td></td>
</tr>
<tr>
<td>A7</td>
<td>Tools and accessories, DDP Gitaru power station</td>
<td></td>
</tr>
<tr>
<td>A8</td>
<td>Spares, DDP Gitaru power station</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL GOODS (DDP, INCLUSIVE OF ALL TAXES)</strong> (A 1+ A 2+ A 3 + A 4+ A 5 + A 6 + A 7 + A 8)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>SERVICES</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Total Services excluding taxes</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Total Taxes Applicable on Services (All taxes payable on Services i.e. withholding taxes, shall be included in the cost by the supplier)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL SERVICES (Inclusive of all taxes) B1 + B2</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>OVERALL TOTAL GOOD, SERVICES AND APPLICABLE TAXES TAKEN TO FORM OF TENDER</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 1+ A 2 + A 3 + A 4+ A 5 +A6 + A 7+ A 8 + B1 + B2</td>
<td></td>
</tr>
</tbody>
</table>

**Delivery period (Months)**

**Bidders Representative name & signature**

**Firms full name as per Registration certificate/certificate of incorporation**

**Date**

---

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Bidders seal or stamp

Price Schedule

January 2020
TENDER FORMS
SECTION VIII STANDARD FORMS

FORM OF TENDER

Date __________________
Tender No. ________________

To: ______________________

[Name and address of procuring entity]

Gentlemen and/or Ladies:

1. Having examined the tender documents including Addenda Nos. ………………………. [Insert numbers]. The receipt of which is hereby duly acknowledged, we, the undersigned, offer to supply and deliver (………………………………………………. (Insert equipment description) in conformity with the said tender documents for the sum of ……………………………………………………………. (total tender amount in words and figures) or such other sums as may be ascertained in accordance with the Schedule of Prices attached herewith and made part of this Tender.

2. We undertake, if our Tender is accepted, to deliver the equipment and offer specified services in accordance with the delivery schedule specified in the Schedule of Requirements.

3. If our Tender is accepted, we will obtain the guarantee of a bank in a sum of equivalent to __ percent of the Contract Price for the due performance of the Contract, in the form prescribed by ……………………. (Procuring entity).

4. We agree to abide by this Tender for a period of 180 days from the date fixed for tender opening of the Instructions to tenderers, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

5. This Tender, together with your written acceptance thereof and your notification of award, shall constitute a Contract, between us, subject to signing of the Contract by the parties.

6. 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 tender for an on behalf of ________________________________

Note: In accordance with Clause 82 of the Public Procurement and Asset Disposal Act 2015 “The tender sum as submitted and read out during the tender opening shall be absolute and final and shall not be the subject of correction, adjustment or amendment in any way by any person or entity.
MANDATORY CONFIDENTIAL BUSINESS QUESTIONNAIRE

(Must be filled by all applicants or Tenderers’ who choose to participate in this tender)

Name of Applicant(s) ........................................................................................................

You are requested to give the particulars in Part 1 and either Part 2 (a), 2 (b) or 2 (c), whichever applies to your type of business. Part 2 (d) to part 2 (i / j) must be filled. You are advised that giving wrong or false information on this Form will lead to automatic disqualification of your tender or termination of your contract or debarment of your firm at your cost.

Part 1 – General
Business Name......................................................................................................................

Certificate of Incorporation / Registration No. .................................................................

Location of business premises:
Country ........................................ County (local companies) ........................................

Physical address (full) ........................................................................................................

Town................................................................................................................................. Building..............................................

Floor................................................................................................................................. Plot No. ..................................................

Street / Road ........................................... Postal Address ............................................

Country Code........................................... Telephone No’s........................................

Fax No’s. .................................................. E-mail address ............................................

Website..............................................................................................................................

Contact Person (Full Names) ............................................................

Direct / Mobile No’s......................

Title ................................................ Power of Attorney (Yes / No) If yes, attach written document.

Nature of Business (Indicate whether manufacturer, distributor, etc)
........................................................................................................................

(Applicable to Local suppliers only)
Local Authority Trading License No. ................... Expiry Date ..........................

KRA PIN No..........................................................

Value of the largest single assignment you have undertaken to date (USD/KShs)
........................................................................................................................

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Was this successfully undertaken? **Yes / No.** ............................ (If Yes, attach reference)
Name(s) of your banker(s)

Branches........................................................................
Tel. No’s.........................................................

**Part 2 (a) – Sole Proprietor (if applicable)**
Full names.....................................................................................
Nationality.......................................................................................... Country of Origin.................................

Company Profile .................................. (Attach brochures or annual reports in case of public company)

**Part 2 (b) – Partnerships (if applicable)**
Give details of partners as follows:

**Full Names Nationality Citizenship Details Shares**
1. .............................................................................................................
2. .............................................................................................................

Company Profile .........................................................

**Part 2 (c) – Registered Company (if applicable - as per the CR12 form)**
Private or public .................................................................
Company Profile .................................. (Attach brochures or annual reports in case of public companies)
State the nominal and issued capital of the Company
Nominal KShs ............................................................... Issued
KShs ..................................................................................

List of top ten (10) shareholders and distribution of shareholding in the company. Give details of all directors as follows:

**Full Names Nationality Citizenship Details Shares**
1................................................................. .............................................
2................................................................. .............................................
3................................................................. .............................................
4................................................................. .............................................
5................................................................. .............................................
6................................................................. .............................................
7................................................................. .............................................
8................................................................. .............................................
9................................................................. .............................................
10................................................................. .............................................

**Part 2 (d) – Debarment**
I/We declare that I/We have not been debarred from any procurement process and shall not engage in any fraudulent, corrupt, coercive and obstructive acts with regard to this or any other tender by the KENGEN and any other public or private institutions.
Full Names ..................................................................................
Signature ..................................................................................
Dated this ................................................ day of ........................................ 2020.
In the capacity of ........................................................................
Duly authorized to sign Tender for and on behalf of ...........................................
Part 2 (e) – Bankruptcy / Insolvency / receivership.
I/We declare that I/We have not been declared bankrupt or insolvent by the competent Authorities in Kenya and neither are we under receivership:
Full Names .................................................................
Signature ........................................................................
Dated this ................................................................. day of ...........................................2020. In the
capacity of ......................................................................
Duly authorized to sign Tender for and on behalf of ..........................................................

Part 2 (f) – Criminal Offence
I/We, (Name(s) of Director(s)):

b) ...........................................................................................................

Have not been convicted of any criminal offence relating to professional conduct or the making of false statements or misrepresentations as to its qualifications to enter into a procurement contract within a period of three (3) years preceding the commencement of procurement proceedings.
Signed ..................................................................................
For and on behalf of M/s ......................................................
In the capacity of ..............................................................
Dated this ................................................................. day of ...........................................2020
Suppliers’ / Company’s Official Rubber Stamp ............................................

Part 2 (g) – Conflict of Interest
I/We, the undersigned state that I / We have no conflict of interest in relation to this procurement:

b)...........................................................................................................

on behalf of M/s ..........................................................................
In the capacity of ..........................................................................
Dated this ................................................................. day of ...........................................2020
Suppliers’ / Company’s Official Rubber Stamp ............................................

Part 2 (h) – Interest in the Firm:
Is there any person/persons in KENGEN or any other public institution who has interest in the
Firm? Yes/No ............... (Delete as necessary) Institution ..............................

......

(Title) (Signature) (Date)

Part 2(i) – Experience:

Please list here below similar projects accomplished or companies / clients you have supplied with
similar items or materials in the last five years.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Country</th>
<th>Contract/Order No.</th>
<th>Value</th>
<th>Contact person (Full Names)</th>
<th>E-mail address</th>
<th>Cell phone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>2</td>
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<td></td>
</tr>
</tbody>
</table>

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Part 2(j or k) – Declaration

I / We, the undersigned state and declare that the above information is correct and that I / We give KENGEN authority to seek any other references concerning my / our company from whatever sources deemed relevant, e.g. Office of the Registrar of Companies, Bankers, etc.

Full names……………………………………

Signature……………………………………………………………

For and on behalf of M/s …………………………………………………

In the capacity of …………………………………………

Dated this .........................................................day of .........................................................2020.

Suppliers’ / Company’s Official Rubber Stamp

……………………………………………………………………

- If a Kenya Citizen, indicate under “Citizenship Details” whether by Birth, Naturalization or Registration.
- Attach CR12 forms and copies of National ID’s of the directors for Kenyan firms (companies incorporated in Kenya)
8.3 TENDER SECURITY FORM
(To be on the Banks Letterhead)

WHEREAS ........................................... [Name of the tenderer]
(Hereinafter called “the tenderer”) has submitted its tender dated ........... [Date of submission of tender] for ................................................... [Name and/or description of the equipment]
(Hereinafter called “the Tender”)

KNOW ALL PEOPLE by these presents that WE ....................... of ......................... having our registered office at ......................... (Hereinafter called “the Bank”), are bound unto the Kenya Electricity Generating Company Limited (hereinafter called “the Procuring entity”) in the sum of ......................... For which payment well and truly to be made to you, 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 the tenderer withdraws its Tender during the period of tender validity specified by the tenderer on the Tender Form; or
2. If the tenderer, having been notified of the acceptance of its Tender by the Procuring entity during the period of tender validity:
   (a) fails or refuses to execute the Contract Form, if required; or
   (b) fails or refuses to furnish the performance security in accordance with the Instructions to tenderers;

We undertake to pay the Procuring entity up to the above amount upon receipt of its first written demand, without the Procuring entity having to substantiate its demand, provided that in its demand the Procuring entity will note that the amount claimed by it is due to it, owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This tender 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 above date.

[Signature of the bank]________________________________

(Amend accordingly if provided by Insurance Company)
CONTRACT FORM

THIS AGREEMENT made the _____ day of ___________ 20 ___ between ................. [name of the Employer] of ............ [country of the Employer] (hereinafter called “the Employer”) of the one part and ................. [name of the Supplier] of ............ [city and country of the Supplier] (hereinafter called “the Supplier”) of the other part;

WHEREAS the Employer invited tenders for ......... | and has accepted a tender by the tenderer for the supply of ............. in the sum of ......................... [contract price in words and figures] (hereinafter called “the Contract Price”).

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 referred to:

2. The following documents shall be deemed to form and be read and construed as part of this Agreement viz:
   (a) the Tender Form and the Price Schedule submitted by the tenderer
   (b) the Schedule of Requirements
   (c) the Technical Specifications
   (d) the General Conditions of Contract
   (e) the Special Conditions of contract; and
   (f) the Procuring entity’s Notification of Award and Tenderer’s Acceptance
   (g) Applicable addenda and clarifications

3. In consideration of the payments to be made by the Procuring entity to the tenderer as hereinafter mentioned, the tenderer hereby covenants with the Procuring entity to provide the goods and to remedy defects therein in conformity in all respects with the provisions of the Contract

4. The Procuring entity hereby covenants to pay the tenderer in consideration of the provisions of the goods 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 hereto have caused this Agreement to be executed in accordance with their respective laws the day and year first above written.

Signed by ........ the ..................... (for the Procuring entity)

Signed by ........ the ..................... (for the tenderer in the presence of .....................)

(Amend accordingly if provided by Insurance Company)
PERFORMANCE SECURITY FORM
(To be on the Banks Letterhead)

To ………………………………………

[name of Procuring entity]

WHEREAS ……………………………………. [name of tenderer] (hereinafter called “the tenderer”) has undertaken, in pursuance of Contract No. __________________________________ [reference number of the contract] for dated _______ 20 _______ to supply ……………………………………………………………………………. [description of goods] (hereinafter called “the Contract”).

AND WHEREAS it has been stipulated by you in the said Contract that the tenderer shall furnish you with a bank guarantee by a reputable bank for the sum specified therein as security for compliance with the Tenderer’s performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the tenderer a guarantee:

NOW THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the tenderer, up to a total of …………………………… [amount of the guarantee in words and figure] and we undertake to pay you, upon your first written demand declaring the tenderer to be in default under the Contract and without cavil or argument, any sum or sums within the limits of …………………………… [amount of guarantee] as aforesaid, without you needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the _______ day of _______ 20 __

Signed and seal of the Guarantors

--------------------------------------------------

[name of bank or financial institution]

--------------------------------------------------

[address]

--------------------------------------------------

[date]
MANUFACTURER’S AUTHORIZATION FORM

To  

[name of the Procuring entity] …………………

WHEREAS …………………………………………………………… [ name of the manufacturer] who are established and reputable manufacturers of ………………. [name and/or description of the goods] having factories at ………………………….. [address of factory] do hereby authorize ……………………… [name and address of Agent] to submit a tender, and subsequently negotiate and sign the Contract with you against tender No. …………………. [reference of the Tender] for the above goods manufactured by us.

We hereby extend our full guarantee and warranty as per the General Conditions of Contract for the goods offered for supply by the above firm against this Invitation for Tenders.

[signature for and on behalf of manufacturer]

Note: This letter of authority should be on the letterhead of the Manufacturer and should be signed by a person authorized by the manufacturer.
Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

SIMILAR EXPERIENCE FORM
Use a separate sheet for each contract.

[Letterhead of the bidder, including full postal address, telephone and fax numbers and e-mail address]

<table>
<thead>
<tr>
<th>Contract Identification</th>
<th>[insert contract name and number, if applicable]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Award date</td>
<td>[insert day, month, year, e.g., 15 June, 2017]</td>
</tr>
<tr>
<td>Completion date</td>
<td>[insert day, month, year, eg., 03 October 2017]</td>
</tr>
<tr>
<td>Role in Contract</td>
<td>[insert &quot;solo contractor&quot; or&quot; Subcontractor” or&quot; partner in a joint venture&quot;]</td>
</tr>
<tr>
<td>Total Contract Amount</td>
<td>[insert total contract amount in Kenya shillings/USD/Euro]</td>
</tr>
<tr>
<td>If partner in a JV, or subcontractor, specify participation in total contract amount</td>
<td>[insert a percentage amount]</td>
</tr>
</tbody>
</table>

**Employer/Client details**

<table>
<thead>
<tr>
<th>Employer's Name:</th>
<th>[insert full name]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>[indicate street / number / town or city / country]</td>
</tr>
<tr>
<td>Telephone</td>
<td></td>
</tr>
<tr>
<td>E-mail:</td>
<td></td>
</tr>
<tr>
<td>Name of Contact person who can converse in English</td>
<td>[insert full name]</td>
</tr>
<tr>
<td>Email of contact person</td>
<td></td>
</tr>
<tr>
<td>Telephone of contact person</td>
<td></td>
</tr>
</tbody>
</table>

**Details of the contract**

<table>
<thead>
<tr>
<th>nature</th>
<th></th>
</tr>
</thead>
</table>
| Tick to indicate the nature of project – tick applicable components of the project | □ design  
□ installation  
□ commissioning  
□ manufacture  
□ supply only |

<table>
<thead>
<tr>
<th>Project specifics</th>
<th></th>
</tr>
</thead>
</table>
| Tick to indicate if the project scope involved any of the following type of equipment. | □ ICT equipment in general  
□ Industrial control panels  
□ Telecommunication/networking equipment  
□ Data centre or rack mount server cabinets  
□ SCADA equipment |

Briefly describe the project
This information is declared to be correct by (Bidder authorized representative)

Name…………………………………………                                   Signature……………………

Position in the Firm…………………………………………

- A copy of signed completion certificate or copy of signed contract agreement and copy of signed payment certificates to be provided for each contract
- only contracts valued above *50 million KES or half a million USD* to be provided for reference
- Bidders **SHALL NOT** attach documents not meeting above criteria or for contracts not similar to the scope of supply
FINANCIAL INFORMATION FORM

The Tenderer, including each of the partners of a joint venture, shall provide the financial information requested below demonstrating the current soundness of their financial positions and long-term profitability as well as evidence of financial resources to meet the Contract cash flow. A separate sheet should be used for each partner of a joint venture. Procuring entity will verify the provided information with the bidder’s bankers, all necessary information and documents required for this shall be provided.

Letterhead of the Bidder, or a JV partner, including full postal address, telephone and fax numbers and e-mail address/

Name of Tenderer or partner of a joint venture

1. Financial reports for the last three years, balance sheets, profit and loss statements, auditors’ reports etc.
List them below and attach copies.

..........................................................................................................................................................................................
..........................................................................................................................................................................................

2. Evidence of access to lines of credit and availability of other financial resources sufficient to meet cash flow of 80% the bid offer price over one year, net of the Tenderer’s or supplier’s commitments for other contracts.

List the documents submitted as evidence and attach copies.

..........................................................................................................................................................................................
..........................................................................................................................................................................................

3. Name, address, telephone, e-mail, fax numbers of the Tenderer’s Bankers who may provide reference if contacted by the Employer.

..........................................................................................................................................................................................
..........................................................................................................................................................................................

This information is declared to be correct by (Tenderer’s authorised representative)

Name…………………………………………                              Signature…………….…

Position in the Firm……………………………………                Date………………………
DEVIAITON FROM TECHNICAL SPECIFICATIONS FORM

No deviations to technical specification shall be acceptable unless specifically indicated in this schedule.
All deviations shall be clearly spelt out by the Bidder.

All the deviations from the specification shall be set out by the bidder, clause by clause, in this schedule.
Unless specifically mentioned in this schedule, the bidder shall be deemed to comply to all technical specifications.

**Letterhead of the Bidder, or a JV partner, including full postal address, telephone and fax numbers and e-mail address/**

**Name of Tenderer or partner of a joint venture**

<table>
<thead>
<tr>
<th>Reference Section/clause and page in the technical specifications</th>
<th>Description of Exceptions/Deviations</th>
<th>Reason for Exception/Deviation</th>
<th>Reference page in the bidders’ offer</th>
</tr>
</thead>
<tbody>
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</table>

This information is declared to be correct by (Tenderer’s authorised representative)

Name…………………………………………                              Signature……………………

Position in the Firm…………………………………………………… Date…………………………
SITE VISIT CERTIFICATE

(A) SITE VISIT CERTIFICATE

This is to certify that (IN BLOCK LETTERS) Name: ________________________________.
______________________________________________________________________________.
ID No. or Passport No. of representative ________________________________.
Cell Phone No: ________________________________________________________________.
Email: ____________________________________________________________________________.
Signature of Bidder representative ____________________________________________.
Being the authorized representative of (IN BLOCK LETTERS)
M/S [Firm /Company]  ____________________________________________________________
______________________________________________________________________________
Official Tel No ________________________________________________________________.
Official Email: ________________________________________________________________.
Bidding firm stamp /seal

Participated in the organized inspection visit of the site of the works for:
TENDER FOR SUPPLY OF SCADA HARDWARE FOR SEVEN FORKS & TURKWEL HYDROELECTRIC POWER
PLANTS

Held on __________ Day of ___________________________ 20____

OFFICIAL USE: -

__________________________.

Signed
(KenGen’s Representative)

__________________________.

(Name of KenGen’s Representative)

(Designation) NOTE:
1. This form is to be completed at the time of the organized site visit.
2. Bidder to bring along with him duly filled site visit certificate during the site visit.
3. Copy/copies of ID of site visit attendee/s to be stamped by the bidding firm and attached to this form, to be brought along during site visit.
(B) FORM OF DECLARATION OF TENDERER’ S KNOWLEDGE OF SITE

1. This is to certify that [Name/s] Being the authorized representative/Agent of [Name of Bidder]

Has undertaken the inspection of site in accordance with the instruction to Bidders, for purposes of bidding for Tender for supply of SCADA hardware for seven forks & Turkwel hydroelectric power plants

Held on....................... Day of.........20........

2. Having studied the tender document, I carefully examined the site to make myself familiar with the local conditions likely to influence the works and cost thereof.

3. I further certify that I am satisfied with the description of the works and I understand perfectly the scope of the works as specified and implied in the performance of the contract

SIGNED AND STAMPED...............................................................

(Bidder’s Representative)