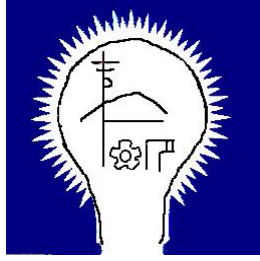


বাংলাদেশ পল্লী বিদ্যুতায়ন বোর্ড



ISO 9001, ISO 14001 &
ISO 45001 Certified

Bangladesh Rural Electrification Board

OFFICE OF THE SUPERINTENDING ENGINEER (GRID &
SUBSTATION), BREB, DHAKA

Tender Document (STD)

For Supply & Installation of Plant & Equipment (National)

TURNKEY CONTRACT FOR UPGRADATION, DESIGN,
SUPPLY, CONSTRUCTION, INSTALLATION, TESTING &
COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI
(HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1.

Invitation for Tender No: 27.12.0000.173.18.018.26.365, Date- 24-03-2026

Tender Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1

Issued to: M/S.....

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Section-I: Instructions to Tenderers

A. General

1. Scope of Tender	1.1	The Procuring Entity, as indicated in the Tender Data Sheet (TDS) issues this Tender Document for the supply and installation of plant and equipment incidental thereto as specified in the TDS and as detailed in Section 6: Schedule of Requirements . The name of the Tender and the number and identification of its constituent lot(s) are stated in the TDS .
	1.2	The successful Tenderer shall be required to execute the Plant and Equipment as specified in the General Conditions of Contract and Particular Conditions of Contract.
2. Interpretation	2.1	(a) the term “in writing” means communication written by hand or machine duly signed and includes properly authenticated messages by facsimile or electronic mail; (b) if the context so requires, singular means plural and vice-versa; (c) “day” means calendar days unless otherwise specified as working days; (d) “Person” means and includes an individual, body of individuals, sole proprietorship, partnership, company, association or cooperative society, NGO that wishes to participate in Procurement proceedings; (e) “Tenderer” means a Person who submits a Tender; (f) “Tender Document” means the Document provided by a Procuring Entity to a Tenderer as a basis for preparation of the Tender; and (g) “Tender” depending on the context, means a Tender submitted by a Tenderer for delivery of Goods to a Procuring Entity in response to an Invitation for Tender. (h) “BPPA” means the Bangladesh Public Procurement Authority formed under the Bangladesh Public Procurement Authority Act, 2023.
3. Source of Funds	3.1	The Procuring Entity has been allocated public funds as indicated in the TDS and intends to apply a portion of the funds to eligible payments under the Contract for which this Tender Document is issued.
	3.2	For the purpose of this provision, “public funds” means any monetary resources appropriated to the Procuring Entity under Government budget, or financing, grants and credits placed at the disposal of the Procuring Entity through the Government by the development partners or foreign states or organisations and also includes any fund of a government, semi-government or a statutory body established by law.
	3.3	Payments by the development partner, if so indicated in the TDS , will be made only at the request of the Government and upon approval by the development partner or foreign state or

		Organisation in accordance with the applicable Financing/ Credit/Grant Agreement, and will be subject in all respects to the terms and conditions of that Agreement.
4. Corrupt, Fraudulent, Collusive, Coercive or Obstructive Practices	4.1	The Government, and the Development Partner, if applicable, requires that the Procuring Entity as well as the Tenderers and Contractors (including sub-contractors, agents, personnel, consultants, and service providers) shall observe the highest standard of ethics during implementation of procurement proceedings and the execution of Contracts under public funds.
	4.2	For the purposes of ITT Sub Clause 4.3, the terms set forth below as follows: (a) “Corrupt practice” means offering or promising to offer, directly or indirectly, any bribe, employment, valuable item or service, or financial benefit to any officer or employee of the Procuring Entity or of any other public or private authority, with the intent to influence any act, decision, or procedure of the Procuring Entity in the course of the procurement process or contract execution, or the acceptance or solicitation of such by any officer or employee of the Procuring Entity. It shall also include any involvement of the Procuring Entity or any of its employees in corrupt, fraudulent, collusive, coercive, or obstructive practices as mentioned in this Rule; (b) “Fraudulent practice” means any act of providing false statements, dishonestly concealing information, or omitting or misrepresenting or distorting facts by any person to influence a decision in the procurement process or contract execution; (c) “Collusive practice” means a scheme or arrangement between two (2) or more Persons, knowingly or unknowingly involving the Procuring Entity or any of its employees, that is designed to arbitrarily reduce the number of Tenders submitted or fix Tender prices at artificial, non-competitive levels, thereby denying the Procuring Entity the benefits of competitive price arising from genuine and open competition; (d) “Coercive practice” means harming or threatening to harm, directly or indirectly, Persons or their property to influence a decision to be taken in the Procurement proceeding or the execution of a Contract, and this will include creating obstructions in the normal submission process used for Tenders. (e) “Obstructive practice” means deliberately destroying, falsifying, altering, or concealing evidence related to a procurement-related investigation, or providing false statements to an investigator so as to impede the investigation of allegations of corrupt, fraudulent, collusive, coercive, or obstructive practices; or intimidating, harassing, or threatening an investigator so as to discourage the disclosure of information or prevent the investigator from carrying out their duties, or directly

		or indirectly obstructing any action undertaken by the Bangladesh Public Procurement Authority (BPPA) in discharging its responsibilities assigned under the Bangladesh Public Procurement Authority Act, 2023.
	4.3	Should any corrupt, fraudulent, collusive, coercive or obstructive practice of any kind be determined by the Procuring Entity or the Development Partner, if applicable, this will be dealt in accordance with the provisions of the Public Procurement Act 2006 and Public Procurement Rules, 2025 and Guidelines of the Development Partners as stated in the ITT sub-clause 3.3.
	4.4	If corrupt, fraudulent, collusive, coercive or obstructive practices of any kind is determined by the Procuring Entity against any Tenderer or Contractors (including sub-contractors, agents, personnel, consultants, and service providers) in competing for, or in executing, a contract under public fund: (a) Procuring Entity and/or the Development Partner shall exclude the concerned Tenderer from further participation in the concerned procurement proceedings; (b) Procuring Entity and/or the Development Partner shall reject any recommendation for award that had been proposed for that concerned Tenderer; (c) Procuring Entity and/or the Development Partner shall declare, at its discretion, the concerned Tenderer to be ineligible to participate (debarment) in any Public Procurement proceedings for a specific period of time; (d) Procuring Entity shall suspend the concerned Tenderer from participating in any other procurement proceedings within the PE organization for the period of finalizing the debarment process; (e) Development Partner shall sanction the concerned Tenderer or individual, at any time, in accordance with prevailing Development Partner' sanctions procedures, including by publicly declaring such Tenderer or individual ineligible, either indefinitely or for a stated period of time: (i) to be awarded a Development Partner-financed contract; and (ii) to be a nominated sub-contractor, consultant, manufacturer or Contractor, or service provider of an otherwise eligible firm being awarded a Development Partner-financed contract; and (f) Development Partner shall cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Procuring Entity or of a beneficiary of the financing engaged in corrupt, fraudulent, collusive, coercive or obstructive practices during the procurement or the execution of that Development Partner financed

		contract, without the Procuring Entity having taken timely and appropriate action satisfactory to the Development Partner to remedy the situation.

	4.5	Tenderer shall be aware of the provisions on corruption, fraudulence, collusion, coercion and obstruction of the Public Procurement Act, 2006, the Public Procurement Rules, 2025 and others as stated in GCC Clause 38.
	4.6	In further pursuance of this policy, Tenderers, Contractors and their sub-contractors, agents, personnel, consultants, service providers shall permit the Government, the BPPA and the Development Partner to inspect any accounts and records and other documents relating to the Tender submission and contract performance, and to have them audited by auditors appointed by the Government, the BPPA and/or the Development Partner during the procurement or the execution of that Development Partner financed contract.
5. Eligible Tenderers	5.1	This Invitation for Tenders is open to all potential Tenderers from all countries, except for any specified in the TDS .
	5.2	Tenderers shall have the legal capacity (not barred by Public Procurement Act or any other law(s) to sign the contract) to enter into the Contract under the Applicable law.
	5.3	Tenderers shall be enrolled in the relevant professional or trade organisations registered in its own country.
	5.4	Tenderers may be a physical or juridical individual or body of individuals, or company, association or any combination of them in the form of a Joint Venture (JV) invited to take part in public procurement or seeking to be so invited or submitting a Tender in response to an Invitation for Tenders.
	5.5	Tenderers shall have fulfilled its obligations to pay taxes and social security contributions, if any, under the provisions of laws and regulations of the country of its origin.
	5.6	Tenderers should not be associated, or have been associated in the past, directly or indirectly, with a consultant or any of its Partners 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 works to be performed under this Invitation for Tenders.
	5.7	Tenderers in its own name or its other names or also in the case of its Persons in different names shall not be under a declaration of ineligibility due to suspension or debarment for corrupt, fraudulent, collusive, coercive or obstructive practices

		as stated under ITT Sub Clause 4.4.
	5.8	Tenderers are not currently restrained due to suspension or debarred from participating in Public Procurement on grounds of fundamental breach of contract under any Contract.
	5.9	Tenderers shall not be insolvent, be in receivership, be bankrupt, be in the process of bankruptcy, be not temporarily barred from undertaking business and it shall not be the subject of legal proceedings for any of the foregoing.
	5.10	Government-owned enterprise in Bangladesh may also participate in the Tender if it is legally and financially autonomous, it operates under commercial law, and it is not a dependent agency of the Procuring Entity.
	5.11	Tenderers shall provide such evidence of their continued eligibility satisfactory to the Procuring Entity, as the Procuring Entity will reasonably request.
	5.12	These above requirements for eligibility will extend, as applicable, to each JV partner and Subcontractor proposed by the Tenderers.
	5.13	A Tenderer shall not have a conflict of interest. Any Tenderer found to have a conflict of interest shall be disqualified. A Tenderer may be considered to have a conflict of interest for the purpose of this Tendering process, if the Tenderer: a) directly or indirectly controls, is controlled by or is under common control with another Tenderer; or b) receives or has received any direct or indirect subsidy from another Tenderer; or c) has the same legal representative as another Tenderer; or d) has a relationship with another Tenderer, directly or through common third parties, that puts it in a position to influence the Tender of another Tenderer, or influence the decisions of the procuring entity regarding this tendering process; or e) any of its partners participated as a consultant in the preparation of the design or technical specifications of the Goods that are the subject of the Tender.
	5.14	A Tenderer shall provide its/their Beneficial Ownership related information, as the specified in Form PG5A-2 , if it/they will be awarded the contract and declare their consent on publishing that information publicly following the signing of contract.
	5.15	A tenderer has not been under restriction imposed by any Development Partner operating in Bangladesh on grounds related to their procurement affairs.

6. Eligible Plants and Services	6.1	All plants and services to be supplied under the Contract are from eligible sources, unless their origin is from a country specified in the TDS and all expenditures under the contract will be limited to such plant, and services.
	6.2	For purposes of this Clause, the term “Plant” means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided in the facilities; and “installation services” means all those services ancillary to the supply of the Plant for the Facilities, such as transportation and provision of marine or other similar insurance, inspection, expediting, site preparation, installation, testing, pre-commissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training etc. For the purposes of this Clause, “origin” means the country where the plant, or component parts thereof are mined, grown, produced or manufactured, and from which the services are provided. Plant components are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that is substantially different in its basic characteristics or in purpose or utility from its components or country where the goods have been mined, grown, cultivated, produced, manufactured or processed; or through manufacture, processing, or assembly, another commercially recognized article results that differs substantially in its basic characteristics from its components or the place from which the related services are supplied.
	6.3	The origin of plant and equipment and associated services is distinct from the nationality of the Tenderer. The nationality of the firm that produces, assembles, distributes, or sells the goods shall not determine their origin.
7. Site Visit	7.1	The Tenderer is advised to visit and examine the site where the plant is to be installed and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the tender and entering into a contract for the provision of Plant and Installation Services.
	7.2	The Tenderer and any of its personnel or agents will be granted permission by the Procuring Entity to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Tenderer, its personnel, and agents will release and indemnify the Procuring Entity and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.
	7.3	The Tenderer should ensure that the Purchaser is informed of the visit in adequate time to allow it to make appropriate arrangements.
	7.4	The costs of visiting the Site shall be at Tenderer’s own expense.

B. Tender Document

8. Tender Document: General	8.1	The Sections comprising the Tender Document are listed below, and should be read in conjunction with any Addendum issued under ITT Clause 11. • Section 1 Instructions to Tenderers (ITT) • Section 2 Tender Data Sheet (TDS) • Section 3 General Conditions of Contract (GCC) • Section 4 Particular Conditions of Contract (PCC) • Section 5 Tender and Contract Forms • Section 6 Procuring Entity's Requirements • Section 7 Drawings
	8.2	The Procuring Entity is not responsible for the completeness of the Tender Document and their addenda, if these were not purchased directly from the Procuring Entity, or through its agent as specified in the TDS .
	8.3	Tenderers are expected to examine all instructions, forms, terms, and specifications in the Tender Document as well as in addendum to Tender, if any.
9. Clarification of Tender Document	9.1	A prospective Tenderer requiring any clarification of the Tender Document shall contact the Procuring Entity in writing at the Procuring Entity's address and within time as specified in the TDS .
	9.2	The Procuring Entity is not obliged to answer any clarification request received after that date as stated under ITT Sub Clause 9.1.
	9.3	The Procuring Entity shall respond in writing within five (5) working days of receipt of any such request for clarification received under ITT Sub Clause 9.1.
	9.4	The Procuring Entity shall forward copies of its response to all those who have purchased the Tender Document, including a description of the enquiry but without identifying its source.
	9.5	Should the Procuring Entity deem it necessary to amend the Tender Document as a result of a clarification, it will do so following the procedure under ITT Clause 11.
10. Pre-Tender Meeting	10.1	To clarify issues and to answer questions on any matter arising in the Tender Document, the Procuring Entity may, if stated in the TDS , hold a pre-Tender Meeting at the place, date and time as specified in the TDS . All potential Tenderers are encouraged and invited to attend the meeting, if it is held.
	10.2	Tenderers are requested to submit any questions in writing so as to reach the Procuring Entity not later than one day prior to the date of the meeting.
	10.3	Minutes of the pre-Tender meeting, including the text of the questions raised and the responses given, together with any responses prepared after the meeting, will be transmitted

		within five (5) working days after holding the meeting to all those who purchased the Tender document and to even those who did not attend the meeting. Any revision to the Tender Document listed in ITT Sub Clause 8.1 that may become necessary as a result of the pre-Tender meeting will be made by the Procuring Entity exclusively through the issue of an Addendum pursuant to ITT Sub Clause 11 and not through the minutes of the pre-Tender meeting.
	10.4	Non-attendance at the Pre-Tender meeting will not be a cause for disqualification of a Tenderer.
11. Addendum to Tender Document	11.1	At any time prior to the deadline for submission of Tenders, the Procuring Entity, on its own initiative or in response to an inquiry in writing from a Tenderer, having purchased the Tender Document, or as a result of a pre-Tender meeting may revise the Tender Document by issuing an Addendum.
	11.2	The Addendum issued under ITT Sub Clause 11.1 shall become an integral part of the Tender Document and shall have a date and an issue number and must be circulated by mail or e-mail, to Tenderers who have purchased the Tender Documents, within five (5) working days of issuance of such Addendum, to enable Tenderers to take appropriate action
	11.3	The Procuring Entity shall also ensure posting of the relevant addenda with the reference number and date on their websites including notice boards, where the Procuring Entity had originally posted the IFTs.
	11.4	The Tenderer shall acknowledge receipt of an addendum.
	11.5	Tenderers who have purchased the Tender Documents but have not received any addendum issued under ITT Sub-clause 11.1 shall inform the Purchaser of the fact by fax, mail or e-mail before two-third of the time allowed for the submission of Tenders has elapsed.
	11.6	To give a prospective Tenderer reasonable time in which to take an addendum into account in preparing its Tender, the Procuring Entity may, at its discretion, extend the deadline for the submission of Tenders, pursuant to ITT Sub Clause 41.2.
	11.7	If an addendum is issued when time remaining is less than one-third of the time allowed for the preparation of Tenders, the Procuring Entity at its discretion shall extend the deadline by an appropriate number of days for the submission of Tenders, depending upon the nature of the Procurement requirement and the addendum. In any case, the minimum time for such extension shall not be less than three (3) working days.

C. Qualification Criteria

12. General Criteria	12.1	Tenderers shall possess the necessary professional and technical qualifications and competence, financial resources, equipment and other physical facilities, managerial capability, specific experience, reputation and the personnel, to perform the contract, which entails setting pass/fail criteria, which if not met by the Tenderers, will result in consideration of its Tender as non-responsive.
	12.2	In addition to meeting the eligibility criteria, as stated in ITT Clause 5, Tenderers must satisfy the other criteria stated in ITT Clauses 13 to 18 inclusive.
	12.3	To qualify for multiple number of contracts/lots in a package made up of this and other individual contracts/lots for which Tenders are invited in the Invitation for Tenders, the Tenderers shall demonstrate having resources and experience sufficient to meet the aggregate of the qualifying criteria for the individual contracts. The requirement of general experience as stated under ITT Sub Clause 13.1(a) and specific experience, unless otherwise of different nature, as stated under ITT Sub Clause 13.1(b) shall not be separately applicable for each individual lot.
13. Experience Criteria	13.1	Tenderers shall have the following minimum level of supply experience to qualify for the supplying of Goods under the Contract: (a) a minimum number of years of general experience in the role of Contractor or Subcontractor or Management Contractor as specified in the TDS; and (b) specific experience as a Contractor or Subcontractor or Management Contractor that are similar to the proposed plant and services in at least a number of contract(s) and, each with a minimum value, over the period, as specified in TDS.
14. Financial Criteria	14.1	Tenderers shall have the following minimum level of financial capacity to qualify for the supply, execution and performance of plant and services under the Contract: (a) satisfactory resolution of all claims under litigation cases and shall not have serious negative impact on the financial capacity of the Tenderers. All pending litigation shall be treated as resolved against the Tenderers; (b) availability of minimum financial resources in any form or combination of forms of liquid assets or credit line(s) or working capital, net of other contractual commitments of the amount as specified in the TDS; and (c) the average annual turnover as specified in the

		TDS calculated as total certified payments received for contracts in progress or completed, during the period specified in the TDS .
15. Personnel Capacity	15.1	The Tenderer shall have the following minimum level of personnel capacity to qualify for the performance of the plant and services under the Contract. A Project Manager, Engineers, and other key staff with qualifications and experience as specified in the TDS;
16. Equipment Capacity	16.1	The Tenderer shall own suitable equipment and other physical facilities or have proven access through contractual arrangement to hire or lease such equipment or facilities for the desired period, where necessary or have assured access through lease, hire, or other such method, of the essential equipment, in full working order, as specified in the TDS .
17. Joint Venture (JV)	17.1	Tenderers may participate in the procurement proceedings forming a Joint Venture(JV) by an agreement, without alterations, in the format as specified in the Format PG5A-2b , executed case by case on a non-judicial stamp of value as specified in the TDS or alternately with the intent to enter into such an agreement supported by a Letter of Intent along with the proposed agreement duly signed by all legally authorised partners of the intended JV and authenticated by a Notary Public, with the declaration that the partners will execute the JV agreement in the event the Tenderer is successful.
	17.2	The figures for each of the partners of a JV shall be added together to determine the Tenderer's compliance with the minimum qualifying criteria; however, for a JV under ITT Sub Clause 17.1, with number of partners as specified in the TDS to qualify, Lead partner and other partners must meet the criteria as specified in the TDS . Failure to comply with these requirements will result in non-responsiveness of the JV Tender.
	17.3	Each partner of the JV shall be jointly and severally liable for the execution of the Contract, all liabilities and ethical and legal obligations in accordance with the Contract terms.
	17.4	JV shall nominate the Lead Partner as Representative or Partner-in-charge being entrusted with the Contract administration and management at Site who shall have the authority to conduct all business for and on behalf of any and all the partners of the JV during the Tendering process and, in the event the JV is awarded the Contract, during contract execution including the receipt of payments for and on behalf of the JV.
	17.5	The business share of the Lead Partner shall be the highest among all the partners. Other partner(s) shall have at least 25% of business share each.
18. Subcontractor (s)	18.1	Tenderers may intend to subcontract an activity or portion of the Plant and Services that will be subcontracted, if any, including the entity (ies) to whom each portion will be subcontracted to, subject to maximum allowable limit for subcontracting of Plant and Services specified in the TDS , in which case such item(s) and the

		proposed Subcontractor shall be clearly identified in the Form PG5A-2c .
	18.2	The Procuring Entity may require Tenderers to provide more information about their subcontracting arrangements. If any Subcontractor is found ineligible or unsuitable to carry out the subcontracted tasks, the Procuring Entity may request the Tenderers to propose an acceptable substitute.
	18.3	A Subcontractor may participate in more than one Tender, but only in that capacity.
	18.4	The Procuring Entity may also select in advance Nominated Subcontractor(s) to execute certain specific components of the Works and if so, those will be specified in the TDS .
	18.5	If a contractor wishes to subcontract an activity or part of the works according to the provision of ITT Clause 18.1 after entering into the contract, it can only be done after approval of Head of the Procuring Entity (HOPE) or an officer authorized by him or her (AO).
	18.6	Any unauthorised subcontracting after entering into the contract shall be considered as fundamental breach of contract.

D. Tender Preparation

19. Only one Tender	19.1	If a Tender for Plants and Services is invited for a number of lots on a "lot-by-lot" basis, each such lot shall constitute a Tender. Tenderers shall submit only one (1) Tender for each lot, either individually or as a JVCA. Tenderer who submits or participates in more than one (1) Tender in one (1) lot of the package will cause all the Tenders of that particular Tenderer to be rejected.
20. Cost of Tendering	20.1	Tenderers shall bear all costs associated with the preparation and submission of its Tender, and the Procuring Entity shall not be responsible or liable for those costs, regardless of the conduct or outcome of the Tendering process.
21. Issuance and Sale of Tender Document	21.1	The Procuring Entity shall make Tender Documents available immediately to the potential Tenderers, requesting and willing to purchase at the corresponding price by the date the advertisement has been published in the newspaper.
	21.2	Full contact details with mailing address, telephone and facsimile numbers and electronic mail address, as applicable, of those to whom Tender Documents have been issued shall be recorded with a reference number by the Procuring Entity.
	21.3	There shall not be any pre-conditions whatsoever, for sale of Tender Documents and the sale of such Document shall be permitted up to the day prior to the day of deadline for the submission of Tender.

22. Language of Tender	22.1	Tenders shall be written in the English language. Correspondences and documents relating to the Tender may be written in English or <i>Bangla</i> . Supporting documents and printed literature furnished by the Tenderers that are part of the Tender may be in another language, provided they are accompanied by an accurate translation of the relevant passages in the English or <i>Bangla</i> language, in which case, for purposes of interpretation of the Tender, such translation shall govern.
	22.2	Tenderers shall bear all costs of translation to the governing language and all risks of the accuracy of such translation.
23. Contents of Tender	23.1	The Tender prepared by the Tenderers shall comprise Two Envelope submitted simultaneously, one called the Technical Offer (Envelope - 01) containing the documents listed in ITT Sub Clause 23.2 and other called the Financial Offer containing the documents listed in 23.3, both envelopes enclosed together in an outer Single envelope.
	23.2	The Technical Offer (Envelope-01) prepared by the Tenderers will comprise the following: (a) the Tender Submission Letters (Form PG5A-1a), as stated under ITT Sub Clause 24.1; (b) the Tenderer Information as stated under ITT Clauses 5, 28 and 31 (Form PG5A-2a); (c) the Tender Security as stated under ITT Clauses 34, 35 and 36. (d) the alternatives, if permissible, as stated under ITT Clause 25; (e) the written confirmation authorizing the signatory of the Tender including National ID to commit the Tenderer if applicable, as stated under ITT Sub Clause 39.4; (f) the Valid Trade license; (g) The Tenderer shall submit with its Tender the following documents as a proof of fulfilling taxation obligations in accordance with ITT Sub Clause 5.5; i. TIN certificate; ii. Acknowledgement slip issued by the competent income tax authority as a proof of submission of income tax return for the Assessment Year as mentioned in the TDS; and iii. Value Added Tax registration certificate/ Business Identification Number. (h) the Technical Proposal describing work plan & method, personnel, equipment and schedules as stated under ITT Clause 30; (i) documentary evidence as stated under ITT Clause 28 and 31 establishing the Tenderer's eligibility and the minimum qualifications of the Tenderers required to be met for due performance of the Works under the Contract; (j) An affidavit confirming the legal capacity stating that there are no existing orders of any judicial court that prevents either the Tenderer or employees of a Tenderer entering into or signing a

		Contract with the Procuring Entity as stated under ITT clause 5; (k) An affidavit confirming that the Tenderer is not insolvent, in receivership or not bankrupt or not in the process of bankruptcy, not temporarily barred from undertaking their business for financial reasons and shall not be the subject of legal proceedings for any of the foregoing as stated under ITT Clause 5; (l) Documentary evidence demonstrating that they are enrolled in the relevant professional or trade organizations registered in Bangladesh or in case of foreign tenderer in their country of origin or a certificate concerning their competency issued by a professional institution in accordance with the law of the country of their origin, as stated under ITT Clause 5; (m) The country of origin declarations, to establish the eligibility of the Plant and Services as stated under ITT Clause 6, in the Price Schedule for Plant and Services (Form PG5A-3) as, applicable, furnished in Section 5: Tender and Contract Forms; (n) Documentary evidence as stated under ITT Clauses 29, that the Goods and Related Services conform to the Tender Documents; (o) Documentary evidence as stated under ITT Clause 31 that the Tenderer's qualifications conform to the Tender Documents; (p) document establishing legal and financial autonomy and compliance with commercial law, as stated under ITT Sub Clause 5.10 in case of government owned entity; (q) In addition to the requirements stated under ITT Sub Clause 18.1, Tenders submitted by a JVCA or proposing a Subcontractor shall include. i. a Joint Venture Agreement entered into by all partners, executed on a non-judicial stamp of value or equivalent as stated under ITT Sub Clause 17.1; or ii. a Letter of Intent along with the proposed agreement duly signed by all partners of the intended JV with the declaration that it will execute the Joint Venture agreement in the event the Tenderer is successful; iii. the JV Partner Information (Form PG5A-2b); iv. the Subcontractor Information (Form PG5A-2c). (r) the completed Specifications Submission and Compliance Sheet (Form PG5A-5) as stated under ITT clause 29.1; (s) Any other document as specified in the TDS.
	23.3	The Financial Offer (Financial Envelope-02) prepared by the Tenderers will comprise the following: (a) the Financial Offer Submission Letter (Form PG5A-1b), as stated under ITT Sub Clause 23.3; (b) the completed Price Schedule for Plant and Services for each lot in accordance with ITT Clauses 24, 26 and 27; (c) the written confirmation authorizing the signatory of the Tender to commit the Tenderer, as stated under ITT Sub Clause 39.4; (d) any other document as specified in the TDS.

24. Tender Submission Letter and Price Schedule	24.1	Tenderers shall submit the Technical Offer Submission Letter (Form PG5A-1a), which shall be completed without any alterations to its format, filling in all blank spaces with the information requested, failing which the Tender may be rejected as being incomplete.
	24.2	Tenderers shall submit the Financial Offer submission letter (Form PG5A-1b) along with priced Schedule using the form(s) furnished in Section 5: Form PG5A-3 (Price Schedule)
	24.3	If in preparing its Tender, the Tenderer has made errors in the unit rate or the total price, and wishes to correct such errors prior to submission of its Tender, it may do so, but shall ensure that each correction is initialled by the authorised person of the Tenderer.
25. Alternatives	25.1	Unless otherwise specified in the TDS , Technical alternatives shall not be considered.
	25.2	When specified in ITT clause 25.1 , Tenderers are permitted to submit alternative technical solutions for specified parts of the Works, and such parts will be identified in the TDS .
	25.3	Only the technical alternatives, if any, of the lowest evaluated Tenderer conforming to the basic technical requirements will be considered by the Procuring Entity.
26. Tender Prices, Discounts and Price Adjustment	26.1	The prices and discounts quoted by the Tenderers in the Tender Submission Letter (Form PG5A-1a and PG5A-1b) and Price Schedule (Form PG5A-3) shall conform to the requirements specified below.
	26.2	Tenderers shall fill in unit rates for all items of the Goods both in figures and in words as described in the Price Schedule, excluding any discount offered.
	26.3	Unless otherwise specified in the TDS , tenderers shall quote for the entire Plant and Installation Services on a “single responsibility” basis such that the total tender price covers all the Contractor’s obligations mentioned in or to be reasonably inferred from the tender document in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the plant. This includes all requirements under the Contractor’s responsibilities for testing, pre-commissioning and commissioning of the plant and, where so required by the tender document, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Tender Document, all in accordance with the requirements of the General Conditions of Contract. Items against which no price is entered by the Tenderer will not be paid for by the Purchaser when executed and shall be deemed to be covered by the prices for other items.
	26.4	Tenderers are required to quote the price for the commercial, contractual and technical obligations outlined in the tender document.
	26.5	Tenderers shall give a breakdown of the prices in the manner and detail called for in the Price Schedules included in Section 5, Tender and Contract Forms.
	26.6	Depending on the scope of the Contract, the Price Schedules may comprise up to the seven (7) schedules listed below. Separate numbered Schedules included in Section 5, Tender Forms, from those numbered 1-4 below, shall be used for each of the elements of the

		Plant and Installation Services. The total amount from each Schedule corresponding to an element of the Plant and Installation Services shall be summarized in the schedule titled Grand Summary, (Schedule 6), giving the total tender price(s) to be entered in the Letter of Tender. Schedule No. 1 Plant (including Mandatory Spare Parts) Supplied from Abroad Schedule No. 2 Plant (including Mandatory Spare Parts) Supplied from within the Purchaser's Country Schedule No. 3 Design Services Schedule No. 4 Civil works part Schedule No. 5 Installation and other Services Schedule No. 6 Grand Summary (Schedule Nos. 1 to 4) Schedule No. 7 Recommended Spare Parts Tenderers shall note that the plant and equipment included in Schedule Nos. 1 and 2 above exclude materials used for civil, building and other construction works. All such materials shall be included and priced under Schedule No. 4, Installation Services.
	26.7	In the Schedules, tenderers shall give the required details and a breakdown of their prices as follows: a) Plant to be supplied from abroad (Schedule No. 1): The price of the plant shall be quoted on CIP-named place of destination/CIF basis as specified in the TDS and as applicable. (b) Plant manufactured within the Purchaser's country (Schedule No. 2): i) The price of the plant shall be quoted on an EXW INCOTERM basis (such as "ex-works," "ex-factory," "ex-warehouse" or "off-the-shelf," as applicable), (ii) Sales tax and all other taxes payable in the Procuring Entity's country on the plant if the contract is awarded to the Tenderer, and (iii) The total price for the item. (c) Design Services (Schedule No. 3). (d) Installation Services shall be quoted separately (Schedule No. 4) and shall include rates or prices for local transportation to named place of final destination as specified in the TDS, insurance and other services

		incidental to delivery of the plant, all labor, contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, including operations and maintenance services, the provision of operations and maintenance manuals, training, etc., where identified in the Tender Document, as necessary for the proper execution of the installation and other services, including all taxes, duties, levies and charges payable in the Procuring Entity's country as of twenty-eight (28) days prior to the deadline for submission of tenders. (e) Recommended spare parts shall be quoted separately (Schedule 6) as specified in either subparagraph (a) or (b) above in accordance with the origin of the spare parts
26.8		The current edition of INCOTERMS, published by the International Chamber of Commerce shall govern.
26.9		The prices shall be either fixed or adjustable as specified in the TDS .
26.10		In the case of Fixed Price , prices quoted by the Tenderer shall be fixed during the Tenderer'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 rejected.
26.11		In the case of Adjustable Price , prices quoted by the Tenderer shall be subject to adjustment during performance of the contract to reflect changes in the cost elements such as labor, material, transport and contractor's equipment in accordance with the procedures specified in the corresponding Appendix to the Contract Agreement. A tender submitted with a fixed price quotation will not be rejected, but the price adjustment will be treated as zero. Tenderers are required to indicate the source of labor and material indices in the corresponding Form in Section 5, Tender and Contract Forms.
26.12		If so, indicated in ITT 19.1, tenders are to be invited for individual lots or for any combination of lots (packages). Tenderers wishing to offer any price reduction (discount) for the award of more than one lot shall specify in their Tender Submission Letter the price reductions applicable to each package, or alternatively, to individual Contracts within the package, and the manner in which the price reductions will apply.
26.13		Tenderers wishing to offer any unconditional discount shall specify in their Letter of Tender the offered discounts and the manner in which price discounts will apply.
26.14		All items or lots in Section 6: Schedule of Requirements must be listed and priced separately on the Price Schedule following the Form PG5A-3 .
26.15		The price to be quoted in Tender Submission Letter (Form PG5A-1a and PG5A-1b) shall be the total price of the Tender, excluding any discounts offered.
26.16		Tenderers shall quote any unconditional discounts and the methodology

		for application of that discount in the Tender Submission Letter as stated under ITT Sub Clause 24.1.
	26.17	Tenderers wishing to offer any unconditional discount for the award of more than one lot shall specify the discount applicable to each lot, or alternatively, to any combination of lots within the package in their Tender. Discounts will be submitted as stated under ITT Sub Clause 26.12, provided the Tenders for all lots are submitted and opened together.
	26.18	All applicable taxes, custom duties, VAT and other levies payable by the Contractor under the Contract, or for any other causes, as of the date twenty-eight (28) days prior to the deadline for submission of Tenders, shall be included in the unit rates and the total Tender price submitted by the Tenderers.
	26.19	If so indicated under ITT Sub Clause 26.9, Tenders are being invited with a provision for price adjustments. The unit rates or prices quoted by the Tenderer are subject to adjustment during the performance of the Contract in accordance with the provisions of the relevant GCC Clause and, in such case the Procuring Entity shall provide the indexes and weightings or coefficients in Appendix to the Tender for the price adjustment formulae specified in the PCC .
	26.20	The Procuring Entity may require the Tenderer to justify its proposed indexes, if any of those as stated under ITT Sub Clause 26.11, are instructed to be quoted by the Tenderer in Appendix to the Tender .
	26.21	The price adjustment stated under ITT Sub Clause 26.9 and 26.11 shall be dealt with in accordance with the provisions in Section 12 and 22 of the Public Procurement Act, 2006 and Rule 4 and 51 of the Public Procurement Rules, 2025.
27. Tender Currency	27.1	For expenditures that will be incurred in Bangladesh, the Tenderer shall quote the prices in Bangladeshi Taka (BDT).
	27.2	Suppliers offering Goods manufactured or assembled in Bangladesh, are permitted to submit their Tender in a combination of local and foreign currencies.
	27.3	In case of National Tender, all quoted price shall be in local currency.
	27.4	In case of international competitive tender, for expenditures that will be incurred outside Bangladesh, the Tenderer may quote the prices as specified in TDS .
28. Documents Establishing Eligibility of the Tenderer	28.1	Tenderers, if applying as a sole Tenderer, shall submit documentary evidence to establish its eligibility as stated under ITT Clause 5 and, in particular, it shall: (a) complete the eligibility declarations in the Tender Submission Letter (Form PG5A-1a and PG5A-1b); (b) complete the Tenderer Information (Form PG5A-2a); (c) complete Subcontractor Information (Form PG5A-2c), if it intends to engage any Subcontractor(s).
	28.2	Tenderers, if applying as a partner of an existing or intended JV shall submit documentary evidence to establish its eligibility as stated under ITT Clause 5 and, in particular, in addition to as stated under ITT Sub Clause 28.1, it shall:

		(a) provide for each JV partner, completed JV Partner Information (Form PG5A-2b); (b) provide the JV agreement as per Format PG5A-2b or Letter of Intent along with the proposed agreement of the intended JV as stated under ITT Sub Clause 17.1.
29. Documents Establishing the Eligibility and Conformity of Plant and Services	29.1	Tenderers shall complete the country of origin declarations in the Price Schedule Forms and, submit documentary evidence to establish the origin of all Goods to be supplied under the Contract as stated under ITT Clause 6.
	29.2	To establish the conformity of the plant and services to the Tender Documents, the Tenderer shall furnish, as part of its Tender, the documentary evidence (which may be in the form of literature, specifications and brochures, drawings or data) that the Goods and Related Services conform to the technical specifications and standards specified in Section 7, Technical Specifications .
	29.3	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 characteristics of the plant and services, including the functional guarantees of the proposed plant and services, in response to the Specification; (b) a list giving full particulars, including available sources, of all spare parts and special tools necessary for the proper and continuing functioning of the plant for the period named in the TDS, following completion of plant and services in accordance with provisions of contract; and (c) a commentary on the Procuring Entity's Technical Specifications demonstrating substantial responsiveness of the plant and services to those specifications. Tenderers shall note that standards for workmanship, materials and equipment designated by the Procuring Entity in the Tender Document are intended to be descriptive (establishing standards of quality and performance) only and not restrictive. The Tenderer may substitute alternative standards, brand names and/or catalog numbers in its tender, provided that it demonstrates to the Procuring Entity's satisfaction that the substitutions are substantially equivalent or superior to the standards designated in the Specification.
30. Documents Establishing Technical Proposal	30.1	Tenderers shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule, risks involved and measures there against and any other information as stipulated in TDS, in sufficient detail to demonstrate the adequacy of the Tenderer's proposal to meet the work requirements and the completion time.
31. Documents Establishing the Tenderer's Qualification	31.1	Tenderers shall complete and submit the Tenderer Information (Form PG5A-2a) and shall include documentary evidence, as applicable to satisfy the following: a) general experience in the supply of Goods as stated under

		ITT Sub Clause 13.1(a), substantiated by the year of Tenderer's registration/constitution/licensing in its country of origin; b) specific experience of satisfactory completion of supply of Goods under public or private sector of similar nature and size as stated under ITT Sub Clause 13.1(b), substantiated by Completion Certificate (s) issued or duly certified, by the relevant Procuring Entity(s); c) information regarding claims under litigation, current or during the last years as specified in the TDS, in which the Tenderer is involved, the parties concerned, and value of claim as stated under ITT Sub Clause 14.1(a), substantiated by statement in its letter-head pad; d) adequacy of minimum liquid asset substantiated by bank statement having previous date's closing balance with three (3) months transaction details; or (ii) updated balance statement on previously approved credit line; or (iii) unconditional specific credit commitment letter issued in the format as specified in Form PG5A-8 without alteration from any scheduled bank of Bangladesh, and issued not earlier than twenty-eight (28) days prior to the day of the initial (if applicable) deadline for submission of Tenders for this Contract as stated under ITT Sub Clause 14.1(b) or (iv) working capital substantiated by audited financial statements mentioned in (h) below; e) if required in the TDS, a Tenderer that does not manufacture or produce the Goods shall submit the Manufacturer's Authorization Letter (Form PG5A-6); f) authority to seek references from the Tenderer's Bankers or any other sources in its letter-head pad; g) reports on the financial standing of the Tenderers, such as profit and loss statements and audited balance sheet for the previous years as specified in the TDS, substantiated by Audit Reports; h) information regarding technical and administrative personnel along with their qualification and experience proposed for the Contract as stated under ITT Clause 15; and i) major items of construction equipment proposed to carry out the Contract as stated under ITT Clause 16, substantiated by statement(s) of the entity(s) participating in the Tender in its letter-head pad declaring source of its availability and documents related to ownership or hiring or leasing.
32. Validity	32.1	Tender validities shall be determined on the basis of the complexity of the

Period of Tender		Tender and the time needed for its examination, evaluation, approval of the Tender and issuance of the Notification of Award (NOA).
	32.2	Tenders shall remain valid for the period as specified in the TDS after the date of Tender submission deadline. A Tender valid for a period shorter than that specified will be considered, non- responsive.
33. Extension of Tender Validity and Tender Security	33.1	In exceptional circumstances, prior to the expiration of the Tender Validity period, the Procuring Entity may solicit all the Tenderers' consent to an extension of the period of validity of their Tenders, subject to a maximum of two times; provided that those Tenderers have passed the preliminary examination as stated under ITT Sub Clauses 46.2.
	33.2	The request for extension of Tender Validity period shall state the new date of the validity of the Tender.
	33.3	The request and the responses shall be made in writing. Validity of the Tender Security provided under ITT Clause 34 shall also be suitably extended for twenty-eight (28) days beyond the new date for the expiry of the Tender Validity. If a Tenderer does not respond or refuses the request it shall not forfeit its Tender Security, but its Tender shall no longer be considered in the evaluation proceedings. A Tenderer agreeing to the request will not be required or permitted to modify its Tender.
34. Tender Security	34.1	Tenderers shall furnish as part of its Technical offer (envelope-1) Tender, in favour of the Procuring Entity or as otherwise directed on account of the Tenderer, a Tender Security in original form (not copy) and in the amount, as specified in the TDS .
	34.2	If the Tender is a Joint Venture, the Tenderer shall furnish as part of its Tender, in favour of the Procuring Entity or as otherwise directed on account of the title of the existing or intended JV or any of the partners of that JV or in the names of all future partners as named in the Letter of Intent of the JV, a Tender Security in original form and in the amount as stated under ITT Sub Clause 34.1.
	34.3	In case of substitution of the Tender as stated under ITT Clause 43.3 a new Tender Security shall be required in the substituted Tender.
35. Form of Tender Security	35.1	The Tender Security shall: (a) at the Tenderer's option, be either; i. in the form of a Bank Draft or Pay Order, or ii. in the form of an irrevocable unconditional Bank Guarantee issued by any scheduled Bank of Bangladesh, in the format (Form PG5A-7) without any alteration, furnished in Section 5: Tender and Contract Forms; (b) In case of ICT, in the form of an irrevocable bank guarantee issued by an internationally reputable bank and shall require to be endorsed by its any correspondent bank located in Bangladesh, to make it enforceable, in the format (Form PG5A-7) furnished in Section 5: Tender and Contract Forms; (c) be payable promptly upon written demand by the Procuring Entity in the case of the conditions as stated under ITT Sub Clause 38.1 being invoked; and

		(d) remain valid for at least twenty-eight (28) days beyond the expiry date of the Tender Validity in order to make a claim in due course against a Tenderer in the circumstances as stated under ITT Sub Clause 38.1.
36 Authenticity of Tender Security	36.1	The authenticity of the Tender Security submitted by a Tenderer may be examined and verified by the Procuring Entity at its discretion in writing from the Bank issuing the security, prior to finalization of the Evaluation Report.
	36.2	If a Tender Security is found to be not-authentic, the Procuring Entity may proceed to take measures against that Tenderer as stated under ITT Sub Clause 4.4.
	36.3	A Tender not accompanied by a valid Tender Security will be considered non-responsive.

37. Return of Tender Security	37.1	No Tender Security shall be returned to the Tenderers before Approval of Evaluation Report.
	37.2	Non-responsive Tenderer's Tender Security will be returned after approval of Evaluation Report but within twenty-eight (28) days of the expiry of the Tender Validity period as stated under ITT Sub Clauses 32.1. The Tender Security of the responsive Tenderers except the 1 st , 2 nd , and 3 rd lowest responsive Tenderers may be returned, in the same manner, upon written request from them to the Procuring Entity.
	37.3	The Tender Security of the 1 st , 2 nd , and 3 rd lowest responsive Tenderers (as the case may be) will be returned upon the successful Tenderer's furnishing of the performance security and signing of the Contract Agreement, if not otherwise subject to ITT Clause 38.1.

38. Forfeiture of Tender Security	38.1	The Tender Security may be forfeited, if a Tenderer: (a) withdraws its Tender after opening of Tenders but within the validity of the Tender as stated under ITT Clause 32 and 33; or (b) does not accept the correction of the Tender price following the correction of the arithmetic errors as stated under ITT Clause 53; or (c) fails to furnish Performance Security or tenderer's submitted Performance Security has been found unauthentic as stated under ITT Sub Clauses 66.1 and 66.2; or (d) refuses or fails to sign the Contract as stated under ITT Sub Clause 71.2. (e) involves in any corrupt, fraudulent, collusive, coercive or obstructive practice of any kind as defined in ITT Clause 4.
39. Format and Signing of Tender	39.1	Tenderers shall prepare one (1) original of the documents comprising the Technical Offer as described in ITT Clause 23.2 and clearly mark it "ORIGINAL OF TECHNICAL OFFER" In addition, the Tenderers shall prepare the number of copies of the Technical Offer, as specified in the TDS and clearly mark each of them "COPY OF THE TECHNICAL OFFER." In the event of any discrepancy between the original and the copies, the ORIGINAL shall prevail.
	39.2	Tenderers shall prepare one (1) original of the documents comprising the Financial Offer as described in ITT Clause 23.3 and clearly mark it "ORIGINAL OF FINANCIAL OFFER" In addition, the Tenderers shall prepare the number of copies of the Financial Offer, as specified in the TDS and clearly mark each of them "COPY OF THE FINANCIAL OFFER" In the event of any discrepancy between the original and the copies, the ORIGINAL shall prevail.
	39.3	Alternatives, if permitted as stated under ITT Clause 22, shall be clearly marked "Alternative".
	39.4	The original and each copy of the Offer shall be typed or written in indelible ink and shall be signed by the Person duly authorized to sign on behalf of the Tenderer. This Tender specific authorization shall be attached to the Technical Offer Submission Letter (Form PG5A-1a) and Financial Offer Submission Letter (Form PG5A-1b). The name and position held by each Person(s) signing the authorization must be typed or printed below the signature. All pages of the original and of each copy of the Tender, except for un-amended printed literature, shall be numbered sequentially and signed by the person signing the Tender. The original and each copy of the Tender shall be typed or written in indelible ink and shall be signed by the Person duly authorized to sign on behalf of the Tenderer. This Tender specific authorization document shall be attached to the Tender Submission Letter (Form PG5A-1c). The name and position held by each Person(s) signing the authorization must be typed or printed below the signature. All pages of the original and of each copy of the Tender, except for un-amended printed literature, shall be numbered

		sequentially and signed by the person signing the Tender.
	39.5	Any interlineations, erasures, or overwriting will be valid only if they are signed or initialled by the Person(s) signing the Tender.

E. Tender Submission

40. Sealing, Marking and Submission of Tender	40.1	Tenderers shall enclose the original of Technical Offer in one (1) envelope and all the copies of the Technical Offer , including the alternatives, if permitted under ITT Clause 25, in another envelope, duly marking the envelopes as “ ORIGINAL OF TECHNICAL OFFER ” “ ALTERNATIVES ” (if permitted), “ COPY OF TECHNICAL OFFER ,” “ ALTERNATIVES ” (if permitted) These sealed envelopes for the original and copies of the technical Tender shall then be enclosed and sealed in one single envelope and clearly mark it “ Envelope-01: TECHNICAL OFFER ”. Tenderers shall enclose the original in one (1) envelope and all the copies of the Tender, including the alternatives, if permitted under ITT Clause 25, in another envelope, duly marking the envelopes as “ORIGINAL (O)” “ALTERNATIVE (A)” (if permitted) and “COPY.” These sealed envelopes will then be enclosed and sealed in one (1) single outer envelope.
	40.2	The inner and outer envelopes of Technical Offer shall: (a) be addressed to the Procuring Entity at the address as stated under ITT Sub Clause 41.1; (b) bear the name of the Tender and the Tender Number as stated under ITT Sub Clause 1.1; (c) bear the name and address of the Tenderer; (d) bear a statement “DO NOT OPEN BEFORE -----” the time and date for Tender opening as stated under ITT Sub Clause 44.1; (e) bear any additional identification marks as specified in the TDS.
	40.3	Tenderers shall enclose the original of Financial Offer in one (1) envelope and all the copies of the Financial Offer in another envelope, duly marking the envelopes as “ ORIGINAL OF FINANCIAL OFFER ” & “ COPY OF FINANCIAL OFFER ”. These sealed envelopes for the original and copies of the Financial Tender shall then be enclosed and sealed in one single envelope and clearly mark it “ ENVELOPE-02: FINANCIAL OFFER ”.
	40.4	The inner and outer envelopes of Financial Offer shall: (a) be addressed to the Procuring Entity at the address as stated under ITT Sub Clause 41.1; (b) bear the name of the Tender and the Tender Number as stated under ITT Sub Clause 1.1; (c) bear the name and address of the Tenderer; (d) bear a statement “DO NOT OPEN BEFORE THE

		TECHNICAL OFFER EVALUATION AND APPROVAL”. (e) bear any additional identification marks as specified in the TDS .
	40.5	The Envelope-01 as stated in ITT Clause 40.1 and Envelope-02 as in ITT Clause 40.3 shall then be enclosed and sealed in one single outer envelope which shall contain the information as stated under ITT Clause 40.2 (a) to (e) & ITT Clause 40.4 (a) to (e).
	40.6	Tenderers are solely and entirely responsible for pre-disclosure of Tender information if the envelope(s) are not properly sealed and marked.
	40.7	Tenders shall be delivered by hand or by mail, including courier services at the address(s) as stated under ITT Sub Clause 41.1.

	40.8	The Procuring Entity will, on request, provide the Tenderer with acknowledgement of receipt showing the date and time when it's Tender was received.
41. Deadline for Submission of Tender	41.1	Tenders shall be delivered to the Procuring Entity at the address specified in the TDS and not later than the date and time specified in the TDS .
	41.2	The Procuring Entity may, at its discretion, extend the deadline for submission of Tender as stated under ITT Sub Clause 41.1, in which case all rights and obligations of the Procuring Entity and Tenderers previously subject to the deadline will thereafter be subject to the new deadline as extended.
	41.3	Tenders shall be received at only one place as specified under ITT Sub Clause 41.1.
42. Late Tender	42.1	Any Tender received by the Procuring Entity after the deadline for submission of Tenders as stated under ITT Sub Clause 41.1 shall be declared LATE and returned unopened to the Tenderer.

43. Modification, Substitution or Withdrawal of Tender	43.1	Tenderers may modify, substitute or withdraw its Tender after it has been submitted by sending a written notice duly signed by the authorized signatory and properly sealed, and shall include a copy of the authorization; provided that such written notice including the affidavit is received by the Procuring Entity prior to the deadline for submission of Tenders as stated under ITT Clause 41.
	43.2	Tenderers shall not be allowed to retrieve its original Tender, but shall be allowed to submit corresponding modification to its original Tender marked as “MODIFICATION (M)” .

	43.3	Tenderers shall not be allowed to retrieve its original Tender, but shall be allowed to submit another Tender marked as "SUBSTITUTION (S)" .
	43.4	Tenderers shall be allowed to withdraw its Tender by a Letter of Withdrawal marked as "WITHDRAWAL(W)" .

F. Tender Opening and Evaluation

44. Tender Opening	44.1	Only the Technical Offer (Envelop-1) shall be opened immediately after the deadline for submission of Tenders at the primary place as specified in the TDS but not later than ONE HOUR , Tenders shall be opened immediately after the deadline for submission of Tenders at the place as specified in the TDS but not later than ONE HOUR after expiry of the submission deadline. Financial offer (Envelop-02) shall not be opened with technical offer (Envelop-1) and shall be kept unopened at the Custody of the Head of the Procuring Entity or his Authorised Officer (AO).
	44.2	Persons not associated with the Tender may not be allowed to attend the public opening of Tenders.
	44.3	Tenderers' representatives shall be duly authorised by the Tenderer. Tenderers or their authorised representatives will be allowed to attend and witness the opening of Tenders, and will sign a register evidencing their attendance.
	44.4	The authenticity of withdrawal or substitution of, or modifications to original Tender, if any made by a Tenderer in specified manner, shall be examined and verified by the Tender Opening Committee (TOC) based on documents submitted as stated under ITT Sub Clause 43.1.
	44.5	Verify (M), (S), (W), (A), (O) by following step by steps (a) Step 1: envelopes marked "Withdrawal (W)" shall be opened and "Withdrawal" notice read aloud & recorded in the opening sheet. After verify the withdrawal letter is genuine, corresponding tender shall not be opened, but returned unopened to the Tenderer by Procuring Entity (PE) at a late time. No Tender withdrawal shall be permitted unless the corresponding withdrawal notice shall be as stated in 43.4 and in such case the Tender shall be opened and recorded. (b) Step 2: the remaining Tenders will be sorted out and those marked "SUBSTITUTION (S)" or "MODIFICATION (M)" of Tender will be linked with their corresponding Original Tender. (c) Step 3: outer envelopes marked "SUBSTITUTION (S)" shall be opened. The inner envelopes containing the "Substitution of Technical Offer

		(STO)" and/or "Substitution of Financial Offer (SFO)" shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Tenderer unopened by the Procuring Entity at a later time immediately after opening of Technical Offers. Only the Substitution of Technical Offer, if any, shall be opened, read out, and recorded. Substitution of Financial Offer will remain unopened in accordance with ITT Sub Clause 45.1. No envelope shall be substituted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out and recorded at Technical Offer opening. (d) Step 4: outer envelopes marked "MODIFICATION (M)" shall be opened. No Technical Offer and/or Financial Offer shall be modified unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Offers. Only the Technical Offers, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Financial Offers, both Original as well as Modification, will remain unopened in accordance with ITT Sub Clause 45.1 (e) Step 5: if so specified in this Tender Document, the envelopes marked "Alternative of Technical Offer (ATO)" shall be opened and read aloud with the corresponding Technical Offer and recorded.
	44.6	Ensuring that only the correct (MTO), (STO), (ATO), (OTO) envelopes are opened, details of each Technical Offer will be dealt with as follows: (a) the Chairperson of the TOC will read aloud each Technical Offer and record in the Technical Offer Opening Sheet (TOOS): (i) the name and address of the Tenderer; (ii) state if it is a withdrawn, modified, substituted or original Technical Offer; (iii) any alternatives; (iv) record the rejection of the Tender which submitted Technical Offer and Financial Offer together in one envelope. (v) the presence or absence of any requisite Tender Security; and (vi) such other details as the Procuring Entity, at its discretion, may consider appropriate.

		(b) Only Technical Offer and alternatives read aloud at the Technical Offer Opening will be considered in evaluation. (a) all pages of the original version of the Technical Offer, except for un-amended printed literature, will be initialled by members of the TOC. Remember, no financial Offer shall be opened with the Technical Offer.
	44.7	Upon completion of Tender opening, all members of the TOC and the Tenderers or Tenderer's duly authorised representatives attending the Tender opening shall sign by name, address, designation, the TOS, copies of which shall be issued to the Head of the Procuring Entity or an officer authorised by him or her and also to the members of the TOC and any authorised Consultants Representatives and, to the Tenderers immediately.
	44.8	The omission of a Tenderer's signature on the record shall not invalidate the contents and effect of the record under ITT Sub Clause 44.7.
	44.9	No Tender i.e., Technical or Financial Offer will be rejected at the Tender opening stage except the LATE Tenders as stated in the ITT Clause 42.
45. Evaluation of Tenders	45.1	Technical Offers shall be examined and evaluated only on the basis of the criteria specified in the Tender Document.
	45.2	Tender Evaluation Committee (TEC) shall examine, evaluate and compare Tenders that are responsive to the requirements of Tender Documents in order to identify the successful Tenderer.
	45.3	TEC may consider a Tender Offer as responsive in the Evaluation, only if it is submitted in compliance with the mandatory requirements set out in the Tender Document. The evaluation process should begin immediately after Technical Offer opening following two steps: (a) Preliminary examination (b) Technical examination and responsiveness
46. Preliminary Examination	46.1	TEC shall examine the Tenders to confirm that all documentations as stated under ITT Clause 23 have been provided, to determine the completeness of each document submitted.
	46.2	TEC shall confirm that the following documents and information have been provided in the Tender. If any of these documents or information is missing, the Tender shall be considered rejected. (a) All Forms, as applicable, duly filled-in and signed, as in Tender Forms (Section 5); (b) Priced Schedule; (c) Written confirmation authorizing the signatory of

		the Tender to commit the Tenderer; and (d) Valid Tender Security.
47. Technical Responsiveness and Technical Evaluation	47.1	Only those Tenders surviving preliminary examination need to be examined in this phase.
	47.2	Secondly, the TEC will examine the adequacy and authenticity of the documentary evidence which may follow the order below: (a) verification of the completeness of the country of origin declaration in the Price Schedule for Plant and Services (Form PG5A-3) as furnished in Section 5: Tender and Contract Forms to determine the eligibility of the Goods and Related Services as stated under ITT Sub Clause 23.2(n). (b) verification and examination of the documentary evidence and completed Technical Proposal (Form PG5A-4) as furnished in Section 5: Tender and Contract Forms to establish the conformity of the Goods and Related Services to the Tender Documents as stated under ITT Sub Clause 23.2 (d) and 23.2(o). (c) verification and examination of the documentary evidence that the Tenderer's qualifications conform to the Tender Documents and the Tenderer meets each of the qualification criterion specified in Sub-Section C, Qualification Criteria as stated under ITT Sub Clause 23.2(p). (d) verification and examination of the documentary evidence that Tenderer has met all the requirements in regards under Section 6, Procuring Entity's Requirements, without any material deviation or reservation. (e) verification and examination of the documentary evidence and completed Specification Submission Sheet (Form PG5A-5) to determine the conformity of the Goods and related services.
	47.3	TEC may consider a Tender as responsive in the evaluation, only if comply with the mandatory requirements as stated under Clause 47.2.
	47.4	The TEC's determination of a Tender's responsiveness is to be based on the documentary evidence as requested in Clause 47.2 without recourse to extrinsic evidence.
	47.5	Information contained in a Tender, that was not requested in the Tender Document shall not be considered in evaluation of the Tender.
	47.6	A responsive Tender is one that conforms in all respects to the requirements of the Tender Document without material

		deviation, reservation, or omission. A material deviation, reservation, or omission is one that: (a) affects in any substantial way the scope, quality, or supply of goods specified in the Contract; or (b) limits in any substantial way, or is inconsistent with the Tender Documents, the Procuring Entity's rights or the Tenderer's obligations under the Contract; or (c) if rectified would unfairly affect the competitive position of other Tenderers presenting responsive Tenders. During the evaluation of Tenders, the following definitions shall apply: "Deviation" is a departure from the requirements specified in the Tender Document; "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Tender Document; and "Omission" is the failure to submit part or all of the information or documentation required in the Tender Document.
	47.7	If a Tender is not responsive to the mandatory requirements set out in the Tender Document, shall not subsequently be made responsive by the Tenderer by correction of the material deviation, reservation, or omission.
	47.8	There shall be no requirement as to the minimum number of responsive Tenders.
	47.9	Provided that a Tender is responsive, TEC may request that the Tenderer submit the necessary information or documentation, within a reasonable period of time to rectify nonmaterial nonconformities or omissions in the Tender related to documentation requirements. Such omission shall not be related to any aspect of the rates of the Tender reflected in the Priced Schedule or any mandatory criteria. Failure of the Tenderer to comply with the request may result in the consideration of its Tender as non-responsive.
	47.10	TEC may regard a Tender as responsive even if it contains: (a) minor or insignificant deviations which do not meaningfully alter or depart from the technical specifications, characteristics and commercial terms and, conditions or other mandatory requirements set out in the Tender Document; or (b) errors or oversights, that if corrected, would not alter the key aspects of the Tender.

48. Clarification on Tender	48.1	TEC may ask Tenderers for clarification of their Technical Offers in order to facilitate the examination and evaluation of Technical Offers. The request for clarification by the TEC and the response from the Tenderer shall be in writing, and Technical Offers clarifications which may lead to a change in the substance of the Technical Offers or in any of the key elements of the Technical Offers as stated under ITT Sub Clause 47.2, will neither be sought nor be permitted.
	48.2	Any request for clarifications by the TEC shall not be directed towards making an apparently non-responsive Tender responsive and reciprocally the response from the concerned Tenderer shall not be articulated towards any addition, alteration or modification to its Tender.
	48.3	The Tenderer shall be provided a reasonable timeline, but not less than three (3) working days, to respond against a clarification request. If a Tenderer does not provide clarifications of its Technical Offer by the date and time, its Tender shall not be considered in the evaluation.
49. Restrictions on Disclosure of Information	49.1	Following the opening of Tenders until issuance of Notification of Award no Tenderer shall, unless requested to provide clarification to its Tender or unless necessary for submission of a complaint, communicate with the concerned Procuring Entity.
	49.2	Tenderers shall not seek to influence in anyway, the examination and evaluation of the Tenders.
	49.3	Any effort by a Tenderer to influence the Procuring Entity in its decision concerning the evaluation of Tenders, Contract awards may result in the non-responsiveness of its Tender as well as further action in accordance with Section 64 (5) of the Public Procurement Act, 2006.
	49.4	All clarification requests shall remind Tenderers of the need for confidentiality and that any breach of confidentiality on the part of the Tenderer may result in their Tender being non-responsive.
50. Approval of Technical Evaluation Report	50.1	TEC shall prepare the Technical Evaluation Report and shall directly submit the Evaluation Report to the Head of the Procuring Entity (HOPE) or Authorized Officer for approval.
51. Financial Offer Opening	51.1	After getting approval of the Technical Offer Evaluation Report, Financial Offer (Envelope-02) of only the Responsive Tenderers who have been determined as qualified to the requirements of the Technical Offer, shall be opened publicly, the date, time and place of Financial Offer Opening shall be communicated to the Responsive Tenderers in writing by issuing a Financial Offer Opening notice not less than seven days before the opening.
	51.2	Ensuring that only the correct MFO, SFO, OFO envelopes of the Responsive Tenderers shall be opened, in the presence of the Responsive Tenderer's representatives who choose to attend, on the date, time and at the place as notified by the Procuring Entity in accordance with ITT Clause 51.1. Details

		of each Technical Offer will be dealt with as follows: (a) the Chairperson of the Tender Evaluation Committee will read aloud each Financial Offer and record in the Financial Offer Opening Sheet (FOOS): (vii) the name and address of the Tenderer; (viii) state if it is a modified, substituted or original Financial Offer; (ix) the Tender Price; (x) the number of initialed corrections; (xi) any discounts; and (xii) any other details as the Procuring Entity, at its discretion, may consider appropriate (b) only the discounts and alternatives read aloud and recorded at the Financial Offer Opening will be considered in Financial Offer Evaluation. No Tenders shall be rejected at the opening of the Financial Offer. (c) all pages of the original version of the Financial Offer, except for un-amended printed literature, will be initialled by members of the Tender Evaluation Committee. The Procuring Entity shall, in writing, notify the Non-responsive Tenderers who have not been determined as qualified to the requirements of the Technical Offer and shall return their Financial Offers (Envelope-02) unopened after signing the Contract Award with the evaluated lowest responsive Tenderer.
52. Clarification on Financial Offer	52.1	TEC may ask Tenderers for clarification of their Financial Offers, about the breakdowns of unit rates, in order to facilitate the examination and evaluation of Financial Offers. The request for clarification by the TEC and the response from the Tenderer shall be in writing.
	52.2	Changes in the Tender price shall not be sought or permitted, except to confirm the correction of arithmetical errors discovered by the TEC in the evaluation of the Tenders, as stated under ITT Sub Clause 55.1.
	52.3	If a Tenderer does not provide clarifications of its Financial Offer by the date and time, its Tender shall not be considered in the evaluation.
	52.4	Requests for clarifications on Financial Offers shall be duly signed only by the TEC Chairperson.

53. Correction of Arithmetical Errors	53.1	Provided that the Tender is responsive, the TEC shall correct arithmetical errors on the following basis: (a) if there is a discrepancy between the unit price and the line item total price that is obtained by multiplying the unit price and quantity, the unit price will prevail and the line item total price shall be corrected, unless in the opinion of the TEC there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted will govern and the unit price will be corrected; and (b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and (c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above.
	53.2	TEC shall correct the arithmetic errors and shall promptly notify the concerned Tenderer(s). If the Tenderer does not accept the correction of arithmetic errors, its Tender shall be rejected.
54. Conversion to Single Currency	54.1	For evaluation and comparison purpose, TEC shall convert all Tender prices expressed in the amounts in various currencies into an amount in Bangladeshi Taka currency, using the selling exchange rates established by the Bangladesh Bank, on the date of Tender opening .
55. Financial Evaluation	55.1	TEC will evaluate each Financial Offer that has been opened duly.
	55.2	To evaluate a Tender, the TEC will consider the following: (a) the Tender price for Item(s) or Lot (b) adjustments for correction of arithmetical errors, as stated under ITT Sub Clause 53.1; (c) Adjustment in order to take into consideration the unconditional discounts and methodology for application of the discount offered for being awarded more than one lot, as stated under ITT Sub Clauses 23.10 and 23.11, if any.
	55.3	If Tenders are invited for a single lot or for a number of lots as stated under ITT Sub-clauses 26.10, TEC shall evaluate only lots that have included at least the percentage of items per lot. The TEC shall evaluate and compare the Tenders taking into account: (a) Lowest evaluated tender for each lot;

		(b) The price discount/reduction per lot; (c) Least cost combination for the Purchaser, considering discounts and the methodology for its application as stated under ITT Sub-clauses 26.16 and 26.17 offered by the Tenderer in its Tender.
	55.4	Only those spare parts and tools which are specified as a item in the List of Goods and Related Services in Section 6, Procuring Entity's Requirement or adjustment as stated under ITT Sub-clause 55.6, shall be taken into account in the Tender evaluation. Supplier-recommended spare parts for a specified operating requirement as stated under ITT Sub-clause 29.3(b) shall not be considered in Tender evaluation.
	55.5	Variations, deviations, alternatives and other factors which are in excess of the requirements of the Tender Document or otherwise result in unsolicited benefits for the Procuring Entity will not be considered in Tender evaluation.
	55.6	The Procuring Entity's evaluation of a Tender may require the consideration of other factors, in addition to the Tender price quoted as stated under ITT Clause 26. The effect of the factors selected, if any, shall be expressed in monetary terms to facilitate comparison of Tenders. The factors, methodologies and criteria to be used shall be as specified in TDS. The applicable economic factors, for the purposes of evaluation of Tenders shall be: (a) adjustment for deviations in the Delivery and Completion Schedule; (b) cost of major replacement components, mandatory spare parts and service.
	55.7	TEC may recommend to increase the amount of the Performance Security above the amounts as stated under ITT Sub Clause 66.1 but not exceeding twenty-five (25) percent of the Contract Price, if in the opinion of the TEC, it is found that the item prices are unbalanced.
56. Identifying Significantly Low-priced Tenders (SLT)	56.1	Prices of all technically responsive Tenderers shall be checked to identify Significantly Low-priced Tender through a specified manner mentioned in the following Sub Clauses.
	56.2	During the evaluation of tenders, the proposed prices of all technically responsive tenderers (at least two tenders) shall be used to determine a Weighted Average, considering: i. the official cost estimate, ii. the prices obtained from the recent Price Index in public procurement processes following ITT Sub Clause 56.4 and iii. the tenderers' quoted prices. The weights shall be as follows: official cost estimate = 0.20

		- Prices obtained from the recent Price Index = 0.30 - Prices quoted by all responsive tenderers = 0.50 The formula shall be: $\bar{x} = 0.5 * \frac{1}{n} \sum_{i=1}^n x_i + 0.2 * x_{OCE} + 0.3 * x_{NPPI}$ Thereafter, the Weighted Standard Deviation (sd) of the quoted prices of all responsive tenders shall be determined using the following formula: $sd = \sqrt{\frac{(x_i - \bar{x})^2}{n}}$ Where: x_i = Quoted prices of tenderers $\bar{x}$ = Weighted Average n = Number of responsive tenderers.
	56.3	Finally, the lower limit of acceptable prices shall be $[\bar{x} - sd]$. Any tender quoted below this limit shall be considered as a significantly low-priced tender and shall be treated as financially non-responsive and rejected.
	56.4	For determining the recent National Public Procurement Price Index, a national average percentage deviation for Goods procurement category shall be calculated from the e-GP system over a period of 28 days-consisting of the day of tender opening and the preceding 27 days.
	56.5	To determine the NPPI, in all procurement processes (except for cases under the Limited Tendering Method in National procurement) where a Notice of Award has been issued during 28-days period, the percentage deviation between the officially estimated price and the awarded tender price shall be calculated, and the national average of such deviations shall be determined. X _{NPPI} shall be determined through multiplication between officially estimated price and NPPI derived from the e-GP system.
	56.6	In the case of only one technically responsive tender, the above methodology shall not be applied; instead, the lowest evaluated price obtained shall be directly compared with the official cost estimate. If the deviation of the evaluated price of the responsive tender from the official estimate exceeds twenty percent (20%), such tender shall be deemed non-responsive. If the deviation of the evaluated price from the official cost estimate is twenty percent (20%) or less, the said tenderer may be recommended for issuance of the Notification of Award subject to successful Post-Qualification verification under ITT Sub Clause 59.

57. Price Comparison	57.1	The lowest-priced Tender among the technically and financially responsive Tenders through ITT Clause 52 shall be determined as the Lowest Evaluated Responsive Tender and shall be recommended for issuance of the Notification of Award subject to successful Post-Qualification verification under ITT Sub Clause 59.
	57.2	In the extremely unlikely event that there is a tie for the lowest evaluated price, the Tender Evaluation Committee shall initially examine the possible presence of collusive practices, and if such practices are found, further actions shall be taken in accordance with Rule 149 of the PPR 2025.
	57.3	Where there is a tie in the lowest evaluated bid but no case of the collusive practice is identified, the Tenderer with the superior past performance with the Procuring Entity shall be selected, whereby factors such as delivery period, quality of Goods delivered, complaints history and performance indicators could be taken into consideration.
	57.4	In the event that there is a tie for the lowest price and none of the Tenderers has the record of past performance with the Procuring Entity as stated under ITT Sub Clause 57.3, then the Tenderer shall be selected, subject to firm confirmation through the Post-qualification process, after consideration as to whether the quality of Goods that is considered more advantageous by the end-users.
	57.5	The successful Tenderer shall not be selected through lottery under any circumstances.
58. Negotiations	58.1	No negotiations shall be held during the financial offer evaluation or award, with the lowest or any other Tenderer.
	58.2	The Procuring Entity through the TEC may, however, negotiate with the lowest evaluated Tenderer with the objective to reduce the Contract Price by reducing the scope of works or a reallocation of risks and responsibilities, only when it is found that the lowest evaluated Tender is significantly higher than the official estimated cost; the reasons for such higher price being duly investigated.
	58.3	If the Procuring Entity decides to negotiate for reducing the scope of the requirements under ITT Sub Clause 58.2, it will be required to guarantee that the lowest Tenderer remains the lowest Tenderer even after the scope of work has been revised and shall further be ensured that the objective of the Procurement will not be seriously affected through this reduction.
	58.4	In the event that the Procuring Entity decides because of a high Tender price to reduce the scope of the requirements to meet the available budget, the Tenderer is not obliged to accept the award and shall not be penalised in any way for un-accepting the proposed award.

59. Post-qualification	59.1	The determination on Post-qualification shall be based upon an examination and verification of the documentary evidence of the Tenderer's eligibility and qualifications submitted by the Tenderer, pursuant to ITT Clauses 28, 30 and 31, clarifications as stated under ITT Clause 48 and the qualification criteria indicated in ITT Clauses 12 to 18. Factors not included therein shall not be used in the evaluation of the Tenderer's qualification.
	59.2	An affirmative determination shall be a prerequisite for award of the Contract to the Tenderer. A negative determination shall result in non-responsiveness of the Tenderer's Tender, in which event the Procuring Entity shall proceed to the next lowest evaluated Tender to make a similar determination of that Tenderer's capabilities to perform the Contract satisfactorily, if awarded.
	59.3	TEC may verify information contained in the Tender by visiting the premises of the Tenderer as a part of the post qualification process, if practical and appropriate.
	59.4	The objective of any visit under ITT Sub-Clause 59.3 shall be limited to a general and visual inspection of the Tenderer's facilities and its plant and equipment, and there shall be no discussion concerning the Tender or its evaluation with the Tenderer during such visit(s).
60. Procuring Entity's Right to Accept any or to Reject Any or All Tenders	60.1	The Procuring Entity reserves the right to accept any Tender or to reject any or all the Tenders any time prior to contract award and, to annul the Procurement proceedings with prior approval of the Head of the Procuring Entity, any time prior to contract award following specified procedures, without thereby incurring any liability to Tenderers, or any obligations to inform the Tenderers of the grounds for the Procuring Entity's action.
61. Rejection of All Tenders	61.1	The Procuring Entity may, in the circumstances as stated under ITT Sub Clause 61.2 reject all Tenders following recommendations from the TEC only after the approval of such recommendations by the Head of the Procuring Entity.
	61.2	All Tenders can be rejected, if - (a) the price of the lowest evaluated Tender exceeds the official estimated cost, provided the estimate is realistic, or (b) there is evidence of lack of effective competition; such as non-participation by a number of potential Tenderers; or (c) the Tenderers are unable to propose completion of the contract within the stipulated time in its Tender, though the stipulated time is reasonable and realistic; or (d) all Tenders are non-responsive; or (e) If, in the tendering process or in the tender documents, any defect, deviation, or

		inconsistency is observed, which appears to hinder the objective of public procurement should the procurement process be continued; or (f) evidence of professional misconduct, affecting seriously the Procurement process, is established pursuant to Rule 149 of the Public Procurement Rules, 2025.
	61.3	Notwithstanding anything contained in ITT Sub-Clause 61.2 Tenders may not be rejected if the lowest evaluated price is in conformity with the market price.
62. Informing Reasons for Rejection	62.1	Notice of the rejection will be given promptly within three (3) working days of decision taken by the Head of the Procuring Entity to all Tenderers and, the Procuring Entity will, upon receipt of a written request, communicate to any Tenderer the reason(s) for its rejection but is not required to justify those reason(s).

G. Contract Award

63. Award Criteria	63.1	The Procuring Entity shall award the Contract to the Tenderer whose Tender is responsive to all the requirements of the Tender Document and that has been determined to be the lowest evaluated Tender, provided further that the Tenderer is determined to be Post-qualified in accordance with ITT Clause 59.
	63.2	Tenderer will not be required, as a condition for award, to undertake responsibilities not stipulated in the Tender Documents, to change its price, or otherwise to modify its Tender.
64. Notification of Award	64.1	Prior to the expiry of the Tender Validity period and within three (3) working days of receipt of the approval of the award by the Approving Authority, the Procuring Entity shall issue the Notification of Award (NOA) to the successful Tenderer.
	64.2	The NOA, (Form PG5A-9) attaching the Contract Agreement as per the sample (Form PG5A-10) to be signed, shall state: (a) the acceptance of the Tender by the Procuring Entity; (b) the price at which the contract is awarded; (c) the amount of the Performance Security and its format; (d) the date and time within which the Performance Security shall be furnished; and (e) the date and time within which the Contract shall be signed.
	64.3	In the event, the Tenders were invited for one (1) or more items on an “item-by-item” basis, contract(s) will comprise the corresponding item(s) awarded to the successful Tenderer(s) and, Contract(s) will be signed per each of the successful Tenderer(s) covering the corresponding item(s).

	64.4	In the event, the Tenders were invited for a single lot, contract will comprise the corresponding items in the lot awarded to the successful Tenderer and, Contract will be signed with the successful Tenderer of the lot, covering the item(s).
	64.5	In the event, the Tenders were invited for a number of lots on a “lot-by-lot” basis, contracts will comprise the corresponding items in a lot awarded to the successful Tenderer(s) and, Contract(s) will be signed per each of the successful Tenderer(s) per lot, covering the corresponding item(s).
65. Reporting on Contract Awarding	65.1	Immediately, but no later than 24 hours, after issuing the Notification of Award, the Procuring Entity shall, for the information of other tenderers and procurement-related stakeholders, publish the contract award details Format PG5A-B on the his/her notice board or on its own website, as well as on the BPPA website. Such information shall remain displayed on the notice board or retained on the website for at least twenty-eight (28) days.
66. Performance Security	66.1	Performance Security shall be provided by the successful Tenderer in BDT currency and within the timeline as mentioned in the TDS .
	66.2	The proceeds of the Performance Security shall be payable to the Procuring Entity unconditionally upon first written demand as compensation for Contractor’s failure to complete its obligations under the Contract.
	66.3	In the event a Government owned enterprise as stated under ITT Sub Clause 5.10 is the successful Tenderer, there shall be Security Deposit as specified in the TDS , in lieu of the Performance Security, as stated under ITT Sub Clause 66.1
67. Form and Time Limit for Furnishing of Performance Security	67.1	Performance Security, as stated under ITT Clause 66, may be in the form of a Bank Draft, or a Pay Order or an irrevocable unconditional Bank Guarantee in the format (Form PG5A-11), without any alteration, issued by any Scheduled Bank of Bangladesh acceptable to the Procuring Entity.
	67.2	Within the timeline mentioned in the TDS from the issuance of the NOA but not later than the date specified therein, the successful Tenderer shall furnish the Performance Security for the due performance of the Contract in the amount as stated under ITT Sub Clauses 66.1 or 66.2.
68. Validity of Performance Security	68.1	Performance Security shall be required to be valid until a date twenty-eight (28) days beyond the Intended Completion Date as specified in Tender Document.
69. Authenticity of Performance Security	69.1	The Procuring Entity shall verify the authenticity of the Performance Security submitted by the successful Tenderer by sending a written request to the branch of the Bank issuing the Pay Order or Bank Draft or irrevocable unconditional Bank Guarantee in specified format.
	69.2	In case of Performance Security being found unauthentic, measures shall be taken following ITT Sub Clause 4.4.

70. Retention Money and Contractual Security	70.1	Upon the completion of delivery of Goods and subsequent acceptance by the TEAC, the Procuring Entity shall deduct from the payment certificate, a retention amount at the percentage rate as mentioned in TDS .
	70.2	The Performance Security mentioned in ITT Sub Clause 66.1 and the money to be retained as per ITT Sub Clause 70.1 will together be considered as the Contractual Security.
	70.3	The Contractual Security against the contract shall not go beyond the amount mentioned in the TDS unless it is recommended by the TEC to extend as mentioned in ITT Sub Clause 70.4.
	70.4	The Procuring Entity shall increase the amount of the Contractual Security on the recommendation of TEC above the amounts as per Rule 36(2) of the PPR 2025.
71. Contract Signing	71.1	At the same time as the Procuring Entity issues the NOA, the Procuring Entity will send the draft Contract Agreement and all documents forming the Contract to the successful Tenderer.
	71.2	Within the timeline mentioned in the TDS from the issuance of the NOA but not later than the date specified therein, the successful Tenderer and the Procuring Entity shall sign the contract.
	71.3	Failure of the successful Tenderer to submit the Performance Security, as stated under ITT Sub Clause 66.1, or to sign the Contract, as stated under ITT Sub Clauses 71.1 and 71.2, shall constitute sufficient grounds for the annulment of the award and forfeiture of the Tender Security. In that event the Procuring Entity may award the Contract to the next lowest evaluated responsive Tenderer, who is determined by the TEC to be qualified to perform the Contract satisfactorily.
72. Notification of Contract Signing	72.1	Immediately, but no later than three (3) days after the signing of contract, the Procuring Entity shall publish the contract-related information, in the format prescribed in Format PG5A-C on the his/her notice board or on its own website. The Procuring Entity shall also publish, on the BPPA website or web portal, the contract-related information together with details of the beneficial ownership of the successful Tenderer. This information shall be kept posted in the notice board or websites for at least thirty (30) days.
73. Debriefing of Tenderers	73.1	Debriefing of Tenderers by the Procuring Entity shall outline the relative status and weakness only of his or her Tender requesting to be informed of the grounds for not accepting the Tender submitted by him or her, without disclosing information about any other Tenderer.
	73.2	In the case of debriefing, confidentiality of the evaluation process shall be maintained.

74. Adjudicator	74.1	The Procuring Entity proposes the person named in the TDS to be appointed as Adjudicator under the Contract, at an indicative hourly fee and for those reimbursable expenses as specified in the TDS .
75. Right to Complain and appeal	75.1	Tenderer has the right to complain and appeal in accordance with the Sections 29 and 30 of Public Procurement Act 2006 and the Rule 72 of Public Procurement Rules, 2025. The Procuring Entity shall cause to dispose of the complaint and appeal in accordance with the provisions of Section 30 of Public Procurement Act 2006 and Rules 72-77 of Public Procurement Rules, 2025.

Section 2. Tender Data Sheet	
ITT Clause	Amendments of, and Supplements to, Clauses in the Instruction to Tenderers
A. General	
ITT 1.1	The Procuring Entity is Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilket, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802- 8900757 E-mail: segridssbreb@gmail.com The Name of the Tender is: TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1. Tender Ref: 27.12.0000.173.18.018.26.365, Date- 24-03-2026
ITT 1.1	The number, identification and name of lots comprising the Tender are: The Name of the Tender is: TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1. Tender Ref: 27.12.0000.173.18.018.26.365, Date- 24-03-2026 Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1
ITT 3.1	The source of public fund is Dhaka PBS-1 Own Fund.
ITT 3.3	The name of the Development Partner is Not Applicable .
ITT 5.1	Tenderers from the following countries are not eligible: All countries except Bangladesh.
ITT 6.1	Materials, Equipment and associated services from the following counties are not eligible: Israel
B. Tender Document	
ITT 8.2	The following are authorised agents/offices of the Procuring Entity for the purpose of issuing the Tender Document: <u>Agent's/office Name:</u> Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilket, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802- 8900757 E-mail: segridssbreb@gmail.com
ITT 9.1	For clarification of Tender Document purposes only, the Procuring Entity's address is: Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilket, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802- 8900757 E-mail: segridssbreb@gmail.com and contact Procuring Entity within Date: 06-04-2026, Time: 10.30AM

ITT 10.1	The Pre- Tender meeting shall be held at Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3 rd Floor, Executive Building, Nikunja-2, Khilkhet, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802 - 8900757 E-mail: segridssbreb@gmail.com Time: 11.00AM Date: 06-04-2026																		
C. Qualification Criteria																			
ITT 13.1(a)	The minimum of years of general experience of the Tenderer in the role of contractor, subcontractor, or management contractor shall be 05 (Five) years.																		
ITT 13.1(b)	The minimum specific experience required as a Contractor or Subcontractor or Management Contractor is as follows: 1. At least 01 (one) no. of contract for construction of 33/11kV or Higher voltage level Substations or 132/33kV grid Sub-station or 33kV or 132kV Bay Breaker Extension work or 33 kV and above voltage level switching station on turnkey basis. The contract having capacity regarding engineering, supply, construction, installation, testing and commissioning of indoor 33/11kV substation or 132/33kV grid substation or 132/33kV Bay Breaker Extension or 33 kV and above voltage level switching station on turnkey basis with a minimum value of BDT 1800.00 Lac Taka within the last 05 years; years counting backward from the date of publication of IFT in the newspaper. 2. In support of experience as mentioned is Serial no. 1 Tenderer shall submit Satisfactory Performance Certificate(s) from the end user's letter head pad. The Certificate(s) shall mention the name & commissioning date of Sub-station, capacity & voltage level which were designed, supplied constructed, tested and commissioned by Tenderer (lead partner in case of JV submission) and shall contain end-user's full mailing address, e-mail address, website address, fax number and phone number for the convenience of authentication. 3. For JV Experience, monetary value of specific experience shall be determined as per ratio of partnership share for evaluation. (Relevant documents have to be submitted for proof).																		
ITT 14.1 (a)	The maximum Three (03) number of arbitration against the Tenderer over a period of the last Five (05) years.																		
ITT 14.1(b)	The minimum amount of financial resources as liquid asset or working capital or credit line(s) or specific credit commitment or in any combination of them, of the Tenderers shall be BDT 1300 Lac .																		
ITT 14.1(c)	The required average annual turnover shall be greater than BDT 3800 Lac over the last three (03) years within the last five (05) years.																		
ITT 15.1	A Project Manager, Engineer, and other key staff shall have the following qualifications and experience: <table><tr><th>No</th><th>Position</th><th>Total Works Experience (Years)</th><th>Experience in similar works (Years)</th></tr><tr><td>1.</td><td>Project Manager (B.Sc.Engineer) Civil / Electrical)- (1 nos.)</td><td>10 Years</td><td>05 Years.</td></tr><tr><td>2.</td><td>Testing/Commissioning Engineer (B.Sc.Engineer-Electrical)- (1 nos)</td><td>5 Years.</td><td>03 Years.</td></tr><tr><td>3.</td><td>Site Engineer (B.Sc./ Diploma Engr.) (Electrical / Mechanical)- (2/2 nos)</td><td>5/10 Years.</td><td>03 Years.</td></tr></table>			No	Position	Total Works Experience (Years)	Experience in similar works (Years)	1.	Project Manager (B.Sc.Engineer) Civil / Electrical)- (1 nos.)	10 Years	05 Years.	2.	Testing/Commissioning Engineer (B.Sc.Engineer-Electrical)- (1 nos)	5 Years.	03 Years.	3.	Site Engineer (B.Sc./ Diploma Engr.) (Electrical / Mechanical)- (2/2 nos)	5/10 Years.	03 Years.
No	Position	Total Works Experience (Years)	Experience in similar works (Years)																
1.	Project Manager (B.Sc.Engineer) Civil / Electrical)- (1 nos.)	10 Years	05 Years.																
2.	Testing/Commissioning Engineer (B.Sc.Engineer-Electrical)- (1 nos)	5 Years.	03 Years.																
3.	Site Engineer (B.Sc./ Diploma Engr.) (Electrical / Mechanical)- (2/2 nos)	5/10 Years.	03 Years.																

	4.	Site Engineer (B.Sc./Diploma Engr.) (Civil)- 2 (Two) nos.	5/10 Years.	03 Years.
	5.	Site Supervisor, Foreman, Lineman for line construction/augmentation works (4 nos)	05 Years	03 Years.
ITT 16.1	The Tenderer shall own or have proven access to hire or lease of the major equipment, in full working order as follows: The tenderer shall submit list of tools & equipment owned by them or have to submit evidence that they own or letter of authorization that they are assured to hire the required equipment, so that they could engage the equipment from the day of starting of the work to ensure the completion of the Project within the specified completion time with the technical proposal.			
ITT 17.1	The value of non-judicial stamp for execution of the Joint Venture Agreement shall be Tk 300 only.			
	Maximum number of partners in the JV shall be 3 (Three) .			
ITT 17.2	Maximum number of partners in the JV shall be 3 (Three) .			
	The minimum qualification requirements of Leading Partner, other Partner(s) and requirements by summation of a JV shall be as follows:			
	ITT Clauses References	Requirements by summation	Requirements for Leading Partner	Requirements for other Partner(s)
	ITT-13.1(a)	Summation not applicable	Same as stated in TDS	Same as for Leading Partner
	ITT-13.1(b)	100% (summation of different contracts)	At least one Contract	Minimum requirement not applicable
	ITT-14.1(b)	100%	40%	25%
	ITT-14.1(c)	100%	40%	25%
	ITT-15.1	100%	Minimum requirement not applicable	Minimum requirement not applicable
	ITT-16.1	100%	Minimum requirement not applicable	Minimum requirement not applicable
	ITT-17.5	100%	Maximum among the Partners	Minimum 25%
D. Preparation of Tender				
ITT 18.1	The maximum of percentage [state percentage] of Goods allowed to be subcontracted: Not Applicable.			
ITT 18.4	The Nominated Subcontractor(s) named [insert name(s)] shall execute the following specific components of the proposed Works: None			
ITT 19.1	Tenders are being invited for Single Lot.			
ITT 23.2(f)	Tenderers shall have the following up to date valid License: ABC License.			
ITT 23.2(s)	The Tenderer shall submit with its technical offer the following additional documents: The Tenderer shall submit the following additional documents furnished below with its Technical Proposal: 1. Tenderers shall furnish copies of ISO 9001/9002 or equivalent certificates of proposed manufacturers for individual equipment, supply record of equipment of the proposed manufacturers as on the date of tender opening and evidence from users satisfactory service mentioned above. The said equipment shall be in satisfactory service in humid tropical climate for a minimum of three (3) years 2. The tenderer shall submit satisfactory type test certificates for the following equipments: 33kV OVCB, Power Transformer, Auxiliary Transformer, Surge Arrestor, Isolator, CT, PT, 11kV Switchgear, Power Cable, Termination kits, Substation Automation System, Battery and Battery Charger. 3. The Tender/manufacturer shall submit with its Tender the following additional documents: All necessary papers, test report, samples, catalogue etc as described in the technical specification of the			

	Tender document. 4. i) The tender shall submit along with offer all type & routine test reports of offered equipment as mentioned in the specification enclosed in the tender document from internationally recognized independent testing laboratory such as KEMA HOLLAND, CESI-ITALY, Under writers Laboratory (UL), U.S.A. CPRI-INDIA or equivalent laboratory for the equipment to be offered. For the test reports from the laboratories other than KEMA, CESI, UL-USA or CPRI, INDIA the tenderer must furnish evidence in support of the status of the laboratories, which should be acceptable to BREB. The Manufacturer's own test report will not be accepted. 5. i. Technical specification and brochures of equipment/plant to be incorporated in the works ii. Letter of authorization to the effect that the Tenderer is authorized to submit Tender on behalf of the respective manufacturers and the Tenderer has the authority to supply equipment to the Employer from the proposed manufacturers for 33kV OVCB, CRP, Power Transformer, Auxiliary Transformer, Surge Arrestor, Isolator, CT, PT, 11kV Switchgear, Power Cable, Termination kits, Demo SAS, Substation Automation System, Battery and Battery Charger, Protective Relays and Steel Structure. iii. Supply records of the manufacturer of 33kV OVCB, CRP, Power Transformer, Auxiliary Transformer, Surge Arrestor, Isolator, CT, PT, 11kV Switchgear, Power Cable, Termination kits, Substation Automation System, Battery and Battery Charger, Protective Relays and Steel Structure. 6. Performance certificates of the above equipment 7. Tender Capacity and Bank solvency certificate from their banker showing capability of handling the projects. Tender capacity will be considered for evaluation. 8. Table of contents with page no. 9. Tender purchased receipt/Document. 10. Power of attorney in favour of the tender signatory. 11. A written confirmation of Authorization to sign on behave of the tenderer. 12. Statement of works in hand to be completed next 01(one) year including its value of uncompleted portion. 13. The required reports on the financial standing, such as profit and loss statements and audited balance sheet shall be for the past 05 (five) years. (B) The required Technical Proposal shall include the following additional information : I. Work plan II. Statement of working method III. Technical specification and brochures of machineries plant to be incorporated in the works. IV. Methodology of foundation, erection and stringing. V. Time Schedule in bar chart. VI. Organogram of the required man power for implementing of this project. VII. Letter of authorization to the effect that the Tendered is authorized to submit the Tender on behalf of the respective manufacturer and that the Tenderer has the authority to supply such equipment to the Procuring Entity from the proposed manufacturers for the construction of the mentioned works. VIII. Personnel required for the work. IX. Equipment's required for the work.
ITT 23.2(g) ii.	Income Tax Assessment Year shall be 2023-24;
ITT 23.3(d)	The Tenderer shall submit with its financial offer the following additional documents: None.
ITT 25.1	Alternatives will not be permitted.
ITT 26.3	Tenderers shall quote for the entire Plant and Installation Services on a single responsibility basis.
26.7(a)	Place of Destination: Palashbari Substation at Savar, Dhaka of Dhaka PBS-1.
26.7(d)	Local transportation to named place of final destination is: Palashbari Substation at Savar, Dhaka of Dhaka PBS-1.
ITT 26.9	The prices quoted by the Tenderer shall be fixed for the duration of the Contract.
ITT 27.4	Name of the foreign currency: Not Applicable.
ITT 29.3 (b)	Spare parts are: As per Schedule-1 of Price Schedule.
ITT 31.1(d)	The required information regarding claims under litigation shall be current or during the last Five (05) years.
ITT 31.1(e)	Manufacturer's Authorization is required as stated in ITT 23.2 (s).

ITT 31.1(g)	The required reports on the financial standing, such as profit and loss statements and audited balance sheet shall be for the past Five (05) years.
ITT 32.2	The Tender Validity period shall be 120 days.
ITT 34.1	The amount of the Tender Security shall be BDT 65.00 Lac in favour of Superintending Engineer (Grid & Sub-Station)
ITT 39.1	In addition to the original of the Tender, 01(One) hard copy and 01 (One) Electronic copy shall be submitted.
E. Submission of Tender	
ITT 40.2 (e)	The inner and outer envelopes shall bear the following additional identification marks: (a) Be addressed to the Procuring Entity at the following address: Attention: Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, Address: Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilket, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802- 8900757 E-mail: segridssbreb@gmail.com (b) bear the following identification: Tender for TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1. Tender Ref :27.12.0000.173.18.018.26.365 Date : 24-03-2026 DO NOT OPEN BEFORE 12:30 PM noon Bangladesh Standard Time on 23-04-2026
ITT 40.4(e)	The inner and outer envelopes shall bear the following additional identification marks: (a) Be addressed to the Procuring Entity at the following address: Attention: Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, Address: Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilket, City: Dhaka-1229, Country: Bangladesh. Tel: + 8802- 8900757 E-mail: segridssbreb@gmail.com (b) bear the following identification: Tender for TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1. Tender Ref: 27.12.0000.173.18.018.26.365 Date: 24-03-2026. DO NOT OPEN BEFORE THE TECHNICAL OFFER EVALUATION AND APPROVAL.
ITT 41.1	For <u>Tender submission purposes</u>, the Procuring Entity's address is: Attention: Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board

	Address: Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3 rd Floor, Executive Building, Nikunja-2, Khilkhet, City: Dhaka-1229, Country: Bangladesh. Tel: + <u>8802</u> - 8900757 E-mail: segridssbreb@gmail.com The deadline for submission of Tenders is: Time & Date: 23-04-2026 up to 12:00 Noon (BST)
F. Opening and Evaluation of Tenders	
ITT 44.1	The Tender opening shall take place at: Address: Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3 rd Floor, Executive Building, Nikunja-2, Khilkhet, City: Dhaka-1229, Country: Bangladesh. Tel: + <u>8802</u> - 8900757 E-mail: segridssbreb@gmail.com Time & Date: 23-04-2026 (BST) On 12:30 PM Noon (BST)
ITT 55.6	The applicable economic factors, for the purposes of evaluation of Tenders shall be: Not Applicable.
G. Award of Contract	
ITT 66.1	The amount of Performance Security shall be ten (10) percent of the Contract Price. The successful Tenderer shall furnish the Performance Security for the due performance of the Contract within working days of issuance of the Notification of Award (NoA) (As per PPR-2025).
ITT 66.3	The Security Deposit shall be deducted @ ten (10) percent from the successful Tenderer's (any government enterprise) payable invoices during Contract implementation, if awarded the Contract.
ITT 70.1	The Procuring Entity shall deduct from the payment certificate, a retention amount at the percentage rate of ten (10) percent from the payment certificate as Retention Money.
ITT 70.3	The Contractual Security against the contract shall not go beyond ten (10) percent of the contract price.
ITT 71.2	The successful Tenderer shall sign the contract with the Procuring Entity within ... days of issuance of the Notification of Award (NoA) (As per PPR-2025).
ITT 74.1	The Adjudicator will be appointed as per situation arise in future. The Hourly fee will be 10000 Tk. BREB will appoint the Adjudicator.

Section-III: General Conditions of Contract

A. General

1. Definitions	1.1	In the Conditions of Contract, which include Particular Conditions and these General Conditions, the following words and expressions shall have the meaning hereby assigned to them. Boldface type is used to identify the defined terms: (a) Act means The Public Procurement Act, 2006 (Act 24 of 2006). (b) Adjudicator is the expert appointed jointly by the Procuring Entity and the Contractor to resolve disputes in the first instance, as provided for in GCC Sub Clause 82.2. (c) Completion means that the Facilities (or a specific part thereof where specific parts are specified in the Contract) have been completed operationally and structurally and put in a tight and clean condition, that all work in respect of Pre-Commissioning of the Facilities or such specific part thereof has been completed, and that the Facilities or specific part thereof are ready for Commissioning (d) Completion Schedule means the fulfilment of the Related Services by the Contractor in accordance with the terms and conditions set forth in the Contract; (e) Start Date is the date defined in the PCC and it is the last date when the Contractor shall commence execution of the goods/works/services under the Contract. (f) Intended Completion Date is the date calculated from the Commencement Date as specified in the PCC, on which it is intended that the Contractor shall complete the Works and Physical services as specified in the Contract and may be revised only by the Project Manager by issuing an extension of time or an acceleration order. (g) Effective Date means the date of fulfilment of all conditions of the Contract Agreement, from which the Time for Completion shall be counted. (h) Completion Certificate means the Certificate issued by the Project Manager as evidence that the Contractor has executed the services in all respects as per design, drawing, specifications and Conditions of Contract. (i) Time for Completion means the time within which Completion of the Facilities as a whole (or of a part of the Facilities where a separate Time for Completion of such part has been prescribed) is to be attained, in accordance with the relevant provisions of the Contract.

		(j) Variation means any change to the plant and services directly procured from the original Contractor to cover increases or decreases in quantities, including the introduction of new work items that are either due to change of plans, design or alignment to suit actual field conditions, within the general scope and physical boundaries of the contract. (k) Schedules means the document(s) entitled schedules, completed by the Contractor and submitted with the Tender Submission Letter, as included in the Contract. Such document may include the data, lists and schedules of rates and/or prices. (l) Contract Agreement means the Agreement entered into between the Procuring Entity and the Contractor, together with the Contract Documents referred to therein, including all attachments, appendices, and all documents incorporated by reference therein; (m) Contract Documents means the documents listed in GCC Clause 7.1, including any amendments thereto. (n) Contract Price means the price stated in the Notification of Award and thereafter as adjusted in accordance with the provisions of the Contract and further clearly determined in the PCC; (o) Operational Acceptance means the acceptance by the Procuring Entity of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of contract (p) Site Investigation Reports are those that were included in the Tender Document and are factual and interpretative reports about the surface and subsurface conditions at the Site. (q) Pre-Commissioning means the testing, checking and other requirements specified in the Procuring Entity's Requirements that are to be carried out by the Contractor in preparation for Commissioning; (r) Commissioning means operation of the Facilities or any part thereof by the Contractor following Completion, which operation is to be carried out by the Contractor for the purpose of carrying out Guarantee Test(s). (s) Guarantee Test(s) means the test(s) specified in the Procuring Entity's Requirements to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Appendix to the

		Contract Agreement titled Functional Guarantees, in accordance with the provisions of GCC Sub-Clause 43.2 (Guarantee Test) hereof. (t) Installation Services means all those services ancillary to the supply of the Plant for the Facilities, to be provided by the Contractor under the Contract, such as transportation and provision of marine or other similar insurance, inspection, expediting, site preparation works (including the provision and use of Contractor's Equipment and the supply of all construction materials required), installation, testing, pre-commissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc. as the case may require. (u) Cost means all expenditures reasonably incurred or to be incurred by the Contractor, whether on or off the point of delivery, including overhead, taxes, duties, fees and such other similar levies including corresponding incidental charges and premiums for banking and insurances, as applicable; (v) Day means calendar day unless otherwise specified as working days. (w) Dayworks means work carried out following the instructions of the Procuring Entity or the authorised Project Manager and is paid for on the basis of time spent by the Contractor's workers and equipment at the rates specified in the Schedules, in addition to payments for associated Materials and Plant. (x) Defect is any part of the Works not completed in accordance with the Contract ; (y) Defect Liability Period means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided in contract document. (z) Defects Correction Certificate is the certificate issued by the Project Manager upon correction of defects by the Contractor (aa) Force Majeure means an event or situation beyond the control of the Contractor that is not foreseeable, is unavoidable, and its origins not due to negligence or lack of care on the part of the Contractor; such events may include, but not be limited to, acts of the Government in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions, and freight embargoes or more as included in GCC Clause 56; (bb) GCC means the General Conditions of Contract. (cc) Government means the Government of the People's

		Republic of Bangladesh. (dd) Goods means raw materials, products and equipment and objects in solid, liquid or gaseous form, electricity, and related Services if the value of such Services does not exceed that of the Goods themselves. It also means mean the Contractor's Plant, Equipment, Materials or any of them as appropriate; (ee) Works means all works associated with the construction, reconstruction, site preparation, demolition, repair, maintenance or renovation of railways, roads, highways, or a building, an infrastructure or structure or an installation or any construction work relating to excavation, installation of equipment and materials, decoration, as well as physical services ancillary to works as detailed in the PCC, if the value of those services does not exceed that of the Works themselves. (ff) Plant means permanent plant, equipment, machinery, apparatus, materials, articles, ancillary buildings/structure and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor), but does not include Contractor's Equipment; (gg) Equipment means all facilities, equipment, machinery, tools, apparatus, appliances or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant, or other things intended to form or forming part of the Facilities. (hh) Facilities means the Plant to be supplied and installed, as well as all the Installation Services to be carried out by the Contractor under the Contract. It also includes any ancillary building or infra structure that needs to be constructed/built/erected to support the plant. (ii) Specification means the Specification of the goods/works/related services included in the Contract and any modifications or additions to the specifications made or approved by the Project Manager in accordance with the Contract. (jj) Materials means things of all kinds other than Plant intended to form or forming part of the Permanent Works, including the supply-only materials, if any, to be supplied by the Contractor under the Contract (kk) "Head of the Procuring Entity" means the Secretary of a Ministry or a Division, the Head of a Government Department or Directorate; or the Chief Executive, or as applicable, Divisional

		Commissioner, Deputy Commissioner, District Judge; or by whatever designation called, of a local Government agency, an autonomous or semi-autonomous body or a corporation, or a corporate body established under the Companies Act; (ll) Procuring Entity/Procuring Entity/Purchaser means an Entity having administrative and financial powers to undertake Procurement of Goods, Works or Services using public funds, as specified in the PCC; (mm) Project Manager is the person named in the PCC or any other competent person appointed by the Procuring Entity and notified to the Contractor who is responsible for supervising the execution and completion of the plant and services and administering the Contract (nn) PCC means the Particular Conditions of Contract; (oo) Approving Authority means the authority which, in accordance with the Delegation of Financial powers, approves the award of Contract for the Procurement of Goods, Works and Services ; (pp) Subcontractor means any natural person, private or government entity, or a combination of the above, to whom any part of the Goods to be supplied or execution of any part of the Related Services is subcontracted by the Contractor; (qq) Contractor/supplier means the Person under contract with the Procuring Entity for the supply and installation of Plant & Equipment under the Rules and the Act as stated in the PCC. (rr) Contractor's Representative means any person nominated by the Contractor and approved by the Procuring Entity to perform the duties delegated by the Contractor. (ss) Drawings include calculations and other information provided in Section 7 or as approved by the Project Manager for the execution and completion of the Contract ; (tt) Site means the point(s) of delivery named in the PCC. (uu) Writing means communication written by hand or machine duly signed and includes properly authenticated messages by facsimile or electronic mail.

2. Interpretation	2.1	In interpreting the GCC, singular also means plural, male also means female or neuter, and the other way around. Headings in the GCC shall not be deemed part thereof or be taken into consideration in the interpretation or construction of the Contract. Words have their normal meaning under the language of the Contract unless specifically defined.
	2.2	Entire Agreement: The Contract constitutes the entire agreement between the Procuring Entity and the Contractor and supersedes all communications, negotiations and agreements (whether written or verbal) of parties with respect thereto made prior to the date of Contract Agreement; except those stated under GCC Sub Clause 7.1(k).
	2.3	Amendment: No amendment or other variation of the Contract shall be valid unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorised representative of each party thereto.
	2.4	Non-waiver: (a) Subject to GCC Sub Clause 2.4(b), no relaxation, forbearance, delay, or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect, or restrict the rights of that party under the Contract, neither shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract. (b) Any waiver of a party's rights, powers, or remedies under the Contract must be in writing, dated, and signed by an authorized representative of the party granting such waiver, and must specify the right and the extent to which it is being waived.
	2.5	Severability: If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.
	2.6	Sectional completion: If sectional completion is specified in the PCC, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).
3. Communications & Notices	3.1	Communications between Parties (notice, request or consent required or permitted to be given or made by one party to the other) pursuant to the Contract shall be in writing to the addresses specified in the PCC .
	3.2	A notice shall be effective when delivered or on the notice's effective date, whichever is later.

	3.3	A Party may change its address for notice hereunder by giving the other Party notice of such change to the address.

4. Governing Law	4.1	The Contract shall be governed by and interpreted in accordance with the laws of the People's Republic of Bangladesh.
5. Governing Language	5.1	The Contract shall be written in English. All correspondences and documents relating to the Contract may be written in English or <i>Bangla</i> . Supporting documents and printed literature that are part of the Contract may be in another language, provided they are accompanied by an accurate translation of the relevant passages in English, in which case, for purposes of interpretation of the Contract, such translation shall govern.
	5.2	The Contractor shall bear all costs of translation to the governing language and all risks of the accuracy of such translation.
6. Corrupt, Fraudulent, Collusive, Coercive or Obstructive Practices	6.1	The Government, and the Development Partner, if applicable, requires that the Procuring Entity as well as the Tenderers and Contractors (including sub-contractors, agents, personnel, consultants, and service providers) shall observe the highest standard of ethics during implementation of procurement proceedings and the execution of Contracts under public funds.
	6.2	For the purpose of GCC Sub Clause 6.2 the terms set forth below as follows– (a) “Corrupt practice” means offering or promising to offer, directly or indirectly, any bribe, employment, valuable item or service, or financial benefit to any officer or employee of the Procuring Entity or of any other public or private authority, with the intent to influence any act, decision, or procedure of the Procuring Entity in the course of the procurement process or contract execution, or the acceptance or solicitation of such by any officer or employee of the Procuring Entity. It shall also include any involvement of the Procuring Entity or any of its employees in corrupt, fraudulent, collusive, coercive, or obstructive practices as mentioned in this Rule; (b) “Fraudulent practice” means any act of providing false statements, dishonestly concealing information, or omitting or misrepresenting or distorting facts by any person to influence a decision in the procurement process or contract execution; (c) “Collusive practice” means a scheme or

		arrangement between two (2) or more Persons, knowingly or unknowingly involving the Procuring Entity or any of its employees, that is designed to arbitrarily reduce the number of Tenders submitted or fix Tender prices at artificial, non-competitive levels, thereby denying the Procuring Entity the benefits of competitive price arising from genuine and open competition; (d) “Coercive practice” means harming or threatening to harm, directly or indirectly, Persons or their property to influence a decision to be taken in a Procurement proceeding or the execution of a Contract, and this will include creating obstructions in the normal submission process used for Tenders (e) “Obstructive practice” means deliberately destroying, falsifying, altering, or concealing evidence related to a procurement-related investigation, or providing false statements to an investigator so as to impede the investigation of allegations of corrupt, fraudulent, collusive, coercive, or obstructive practices; or intimidating, harassing, or threatening an investigator so as to discourage the disclosure of information or prevent the investigator from carrying out their duties, or directly or indirectly obstructing any action undertaken by the Bangladesh Public Procurement Authority (BPPA) in discharging its responsibilities assigned under the Bangladesh Public Procurement Authority Act, 2023.
	6.3	Should any corrupt, fraudulent, collusive, coercive or obstructive practice of any kind, in competing for or in executing the Contract, is determined by the Procuring Entity, then the Procuring Entity may, upon giving 14 days’ notice to the Contractor, terminate the Contractor’s employment under the Contract and the provisions of Clause 73 shall apply as if such expulsion had been made under Sub-Clause 73.1 (Termination for Default).
	6.4	If corrupt, fraudulent, collusive, coercive or obstructive practice of any kind, determined by the Procuring Entity or the Development Partner (if applicable) against the Contractor alleged to have carried out such practices, the Procuring Entity and/or the Development Partner shall;

		(a) exclude the Contractor from further participation in the particular Procurement proceeding; or (b) declare, at its discretion, the Contractor to be ineligible to participate in further Procurement proceedings, either indefinitely or for a specific period of time.
	6.5	The Contractor shall be aware of the provisions on corruption, fraudulence, collusion, coercion and of the Public Procurement Act, 2006, the Public Procurement Rules, 2025 and in case of Development Partner financed contract, the Procurement Guidelines of the Development Partner.
	6.6	The Contractor (including its manufacturers, sub-contractors, agents, personnel, consultants and service providers) shall permit the Government and/or the Development Partner to inspect the Contractor's accounts and records and other documents relating to the submission of Tender and contract performance, and to have them audited by auditors appointed by the Government and/or the Development Partner, if so required.
7. Documents Forming the Contract and Priority of Documents	7.1	The following documents forming the Contract shall be in the following order of precedence, namely: (a) The signed Contract Agreement; (b) The Notification of Award; (c) The Completed Tender and the Appendix to the Tender; (d) Particular Conditions of Contract; (e) General Conditions of Contract; (f) Technical Specifications; (g) Personnel Information; (h) Equipment Information; (i) Drawings; (j) Priced Schedule for Plant and Services (PG5A-3) and Schedule of Requirements and; (k) Other Documents including correspondences listed in the PCC forming part of the Contract.
8. Assignment	8.1	The Contractor shall not assign his rights or obligations under the Contract, in whole or in part, except with the Procuring Entity's prior written consent.
9. Eligibility	9.1	The Supplier/Contractor and its Subcontractor(s) shall have the nationality of a country other than that specified in the PCC .
	9.2	All Goods and related services to be supplied under the Contract shall have their origin in the countries except any specified in the PCC .
10. Gratuities /	10.1	No fees, gratuities, rebates, gifts, commissions or other payments, other than those shown in the Tender or in the

Agency fees		Contract, have been given or received in connection with the procurement process or in the Contract execution.
11. Confidential Details	11.1	The Procuring Entity and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data, or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during or following completion or termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor such documents, data, and other information it receives from the Procuring Entity to the extent required for the Subcontractor to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor an undertaking of confidentiality similar to that imposed on the Contractor under GCC Clause 11.
	11.2	The Procuring Entity shall not use such documents, data, and other information received from the Contractor for any purposes unrelated to the Contract. Similarly, the Contractor shall not use such documents, data, and other information received from the Procuring Entity for any purpose other than the design, construction, or other work and services required for the performance of the Contract.
	11.3	The obligations of a party under GCC Sub Clauses 11.1 and 11.2 above, however, shall not apply to information that: the Procuring Entity or Contractor needs to share with institutions participating in the financing of the Contract; now or hereafter enters the public domain through no fault of that party; can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party; or otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality.
	11.4	The above provisions of GCC Clause 11 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Works or any part thereof.
	11.5	Any document, other than this Contract itself, enumerated in GCC Clause 12.1 shall remain the property of the Procuring Entity and shall be returned (all copies) to the Procuring Entity on completion of the Contractor's performance under this Contract if so required by the Procuring Entity.
	11.6	The provisions of GCC Clause 11 shall survive completion or termination, for whatever reason
12. Trademark, Patent and Intellectual Property Rights	12.1	The Procuring Entity should not be liable for any infringement of intellectual property rights arising from use of the goods procured. In case there are third-party claims of such infringement of patent, trademark, or industrial design rights, the Contractor must indemnify and hold the Procuring Entity free and harmless against such claims and shall not be in

		contravention of Trademark Act, 2009 and Patent and Design Act, 1911.
13. Copyright	13.1	The copyright in all drawings, documents, and other materials containing data and information furnished to the Procuring Entity by the Contractor herein shall remain vested in the Contractor, or, if they are furnished to the Procuring Entity directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party.
14. License/ Use of Technical Information	14.1	For the operation and maintenance of the Plant, the Contractor hereby grants a non-exclusive and non-transferable license (without the right to sub-license) to the Procuring Entity under the patents, utility models or other industrial property rights owned by the Contractor or by a third Party from whom the Contractor has received the right to grant licenses thereunder, and shall also grant to the Procuring Entity a non-exclusive and non-transferable right (without the right to sub-license) to use the know-how and other technical information disclosed to the Procuring Entity under the Contract. Nothing contained herein shall be construed as transferring ownership of any patent, utility model, trademark, design, copyright, know-how or other intellectual property right from the Contractor or any third Party to the Procuring Entity.
15. Joint Venture (JV)	15.1	If the Contractor is a JV, (a) each partner of the JV shall be jointly and severally liable for all liabilities and ethical or legal obligations to the Procuring Entity for performance of the Contract; (b) the JV partners shall nominate the Leading Partner as Representative or Partner-in-charge being entrusted with the Contract administration and management at Site who shall have the authority to conduct all business including the receipt of payments for and on behalf of all partners of the JV; (c) If there is a dispute that results in legal action being taken in court then action will be taken against all partners of the JV, if they are available and, if only one partner is available, then that partner alone shall answer on behalf of all partners and, if the complaint lodged is proven, the penalty shall be applicable on that partner alone as whatever penalty all the partners would have received; provided that if the other partners of the JV subsequently become available before the legal action has been completed, the Procuring Entity shall have the right to take action against those other partners of that JV as well. (d) the composition or constitution and legal status of the

		JV shall not be altered without the prior approval of the Procuring Entity; (e) alteration of partners, except the Leading partner, shall only be allowed if any of them is found to be incompetent or has any serious difficulties which may impact the overall implementation of the Works, whereby the incoming partner shall require to possess qualifications higher than that of the outgoing partner; (f) The business share of the Leading Partner shall be the highest among all the partners. Other partner(s) shall have at least 25% of business share each.
16. Nominated Subcontractor	16.1	Nominated Subcontractor named in the Contract shall be entitled to execute the specific components of the Works stated in the PCC .
	16.2	The Contractor shall not be under obligations to employ a Nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars while there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength, or does not accept to indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, or does not accept to enter into a subcontract which specifies that, for the subcontracted work including design, if any, the Nominated Subcontractor shall undertake to the Contractor such obligations and liabilities as will enable the contractor to discharge his or her liabilities under the Contract.
17. Other Contractors	17.1	The Contractor shall cooperate and share the Site with other Contractors, public authorities, utilities, the Engineer and the Procuring Entity between the dates given in the Schedule of other Contractors. The Contractor shall also provide facilities and services for them as described in the Schedule. The Procuring Entity may modify the Schedule of other Contractors, and shall notify the Contractor of any such modification.
18. Possession of the Site	18.1	The Procuring Entity shall give possession of the Site or part(s) of the Site, to the Contractor on the date(s) stated in the PCC . If possession of a part of the Site is not given by the date stated in the PCC , the Procuring Entity will be deemed to have delayed the start of the relevant activities, and this will be a Compensation Event.
19. Access to the Site	19.1	The Contractor shall allow the Engineer and any person authorised by the Engineer access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

20. Safety, Security and Protection of the Environment	20.1	The Contractor shall throughout the execution and completion of the Works and the remedying of any defects therein: (a) take all reasonable steps to safeguard the health and safety of all workers working on the Site and other persons entitled to be on it, and to keep the Site in an orderly state; (b) provide and maintain at the Contractor's own cost all lights, guards, fencing, warning signs and watching for the protection of the Works or for the safety on-site; and (c) take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of the Contractors methods of operation.
21. Working Hours	21.1	The Contractor shall not perform any work on the Site on the weekly holidays, or during the night or outside the normal working hours, or on any religious or public holiday, without the prior written approval of the Project Manager.
22. Welfare of Laborers	22.1	The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's personnel relating to their employment, health, safety, welfare, immigration and shall allow them all their legal rights.
	22.2	The Contractor, in particular, shall provide proper accommodation to his or her labourers and arrange proper water supply, conservancy and sanitation arrangements at the site for all necessary hygienic requirements and for the prevention of epidemics in accordance with relevant regulations, rules and orders of the government.
	22.3	The Contractor, further in particular, shall pay reasonable wages to his or her labourers, and pay them in time. In the event of delay in payment the Procuring Entity may effect payments to the labourers and recover the cost from the Contractor.
	22.4	The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take appropriate protective measures to prevent accidents that could result in injury. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.
23. Subcontractor	23.1	Subcontracting the whole of the Plant and Service by the Contractor shall not be permissible. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his or her agents or employees, as if they were the acts or defaults of

		the Contractor.
	23.2	Any subcontracting arrangements made during contract implementation and not disclosed at the time of the Tendering shall not be allowed.
	23.3	Subcontracting of any portion of the works shall not relieve the Contractor from any liability or obligations that may arise from its performance.
	23.4	Contractor shall retain full responsibility for the contract and cannot pass any contractual obligations to the Subcontractor and under no circumstances assignment of the contract to the Subcontractor be allowed.
	23.5	The Contractor shall not be required to obtain consent from the Project Manager or his representative, for suppliers solely of Materials or to a subcontract for which the Specialist Subcontractor(s) is already named in the Contract.
	23.6	The prior consent, in writing, of the Engineer shall however be obtained for other proposed Subcontractor(s).
	23.7	Subcontractors shall comply with the provisions of GCC Clause 6 and 11.
24. Dayworks	24.1	If applicable, the Dayworks rates in the Contractor's Tender shall be used for small additional amounts of work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.
	24.2	All works to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be certified and signed by the Project Manager within seven (7) days of the works being done.
	24.3	The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.
25. Child Labor	25.1	The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development in compliance with the applicable laws and other relevant treaties ratified by the government.
26. Fossils& antiquities	26.1	All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Procuring Entity. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

	26.2	The Contractor shall, upon discovery of any such finding, promptly give notice to the Project Manager, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs cost from complying with the instructions, the Contractor shall give a further notice to the Project Manager and shall be entitled subject to Claims under GCC Clause 81.
B. Subject Matter of Contract		
27. Scope of Facilities	27.1	Unless otherwise expressly limited in the Procuring Entity's Requirements, the Contractor's obligations cover the provision of all Plant and the performance of all Installation Services required for the design, and the manufacture (including procurement, quality assurance, construction, installation, associated civil works, Pre Commissioning and delivery) of the Plant, and the installation, completion and commissioning of the Facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Section, Procuring Entity's Requirements. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labor, materials, equipment, spare parts and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures and facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site); and storage, except for those supplies, works and services that will be provided or performed by the Procuring Entity, as set forth in the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity
	27.2	The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract
	27.3	In addition to the supply of Mandatory Spare Parts included in the Contract, the Contractor agrees to supply spare parts required for the operation and maintenance of the Facilities for the period specified in the PCC and the provisions, if any, specified in the PCC . However, the identity, specifications and quantities of such spare parts and the terms and conditions relating to the supply thereof are to be agreed between the Procuring Entity and the Contractor, and the price of such spare parts shall be that given in Price Schedule No.1 & 2 under form PG5A-3 , which shall be added to the Contract Price. The price of such spare parts shall include the purchase price therefor and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts.
28. Time for Commencement	28.1	The Contractor shall attain Completion of the Facilities or of a part where a separate time for Completion of such part is specified in the Contract, within the time stated in the PCC or within such extended time to which the Contractor shall be entitled under GCC Clause 70.2 hereof

29. Time for Completion	29.1	The Contractor shall attain Completion of the Facilities or of a part where a separate time for Completion of such part is specified in the Contract, within the time stated in the PCC or within such extended time to which the Contractor shall be entitled under GCC Clause 70.2 hereof.
30. Procuring Entity's Responsibilities	30.1	Whenever the performance of the obligations in this Contract requires that the Contractor obtain permits, approvals and other license from local public authorities, the Procuring Entity may, if so needed by the Contractor, make its best effort to assist the Contractor in complying with such requirements in a timely and expeditious manner. However, the Contractor shall bear the costs of such permits and/or licenses.
	30.2	The Procuring Entity shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity. The Procuring Entity shall give full possession of and accord all rights of access thereto on or before the date(s) specified in that Appendix.
	30.3	The Procuring Entity shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which (a) such authorities or undertakings require the Procuring Entity to obtain in the Procuring Entity's name, (b) are necessary for the execution of the Contract, including those required for the performance by both the Contractor and the Procuring Entity of their respective obligations under the Contract, and (c) are specified in the Appendix (Scope of Works and Supply by the Procuring Entity).
	30.4	If requested by the Contractor, the Procuring Entity shall use its best endeavours to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain
	30.5	Unless otherwise specified in the Contract or agreed upon by the Procuring Entity and the Contractor, the Procuring Entity shall provide sufficient, properly qualified operating and maintenance personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature, including those required by the Contractor to properly carry out Pre Commissioning, Commissioning and Guarantee Tests, all in accordance with the provisions of the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity, at or before the time specified in the program furnished by the Contractor under the provisions of contract specified or as otherwise agreed upon by the Procuring Entity and the Contractor.

	30.6	The Procuring Entity shall be responsible for the continued operation of the Facilities after Completion, in accordance with GCC Sub-Clause 42.8, and shall be responsible for facilitating the Guarantee Test(s) for the Facilities, in accordance with GCC Sub-Clause 43.2.
	30.7	All costs and expenses involved in the performance of the obligations under this GCC Clause 30 shall be the responsibility of the Procuring Entity, save those to be incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with GCC Sub-Clause 43.2.
	30.8	In the event that the Procuring Entity shall be in breach of any of his obligations under this Clause, the additional cost incurred by the Contractor in consequence thereof shall be determined by the Project Manager and added to the Contract Price
31. Contractor's Responsibilities	31.1	The Contractor shall design, manufacture including associated purchases and/or subcontracting, install and complete the Facilities in accordance with the Contract. When completed, the Facilities should be fit for the purposes for which they are intended as defined in the Contract.
	31.2	The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities including any data as to boring tests provided by the Procuring Entity, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site if access thereto was available and of other data readily available to it relating to the Facilities as of the date twenty-eight (28) days prior to tender submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities
	31.3	The Contractor shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which such authorities or undertakings require the Contractor to obtain in its name and which are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals and/or licenses that are not the responsibility of the Procuring Entity under GCC Sub-Clause 30.3 hereof and that are necessary for the performance of the Contract.
32. Procuring Entity's and Contractor's Risk	32.1	The Procuring Entity carries the risks that the Contract states are Procuring Entity's risks and the Contractor carries the risks that the Contract states are Contractor's risks
33. Procuring Entity's Risks	33.1	From the Start Date until the Defects Correction Certificate has been issued, the following are Procuring Entity's risks: (g) the risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to

		i. use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or ii. negligence, breach of statutory duty, or interference with any legal right by the Procuring Entity or by any person employed by or Contracted to him except the Contractor. iii. the risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Procuring Entity or in the Procuring Entity's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.
	33.2	From the Completion Date until the Defects Correction Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is Procuring Entity's risk, except loss or damage due to: (a) a Defect which existed on the Completion Date; (b) an event occurring before the Completion Date, which was not itself Procuring Entity's risk; or (c) the activities of the Contractor on the Site after the Completion Date.
34. Contractor's Risks	34.1	From the Start Date until the Defects Correction Certificate has been issued the risks of personal injury, death, and loss of or damage to property including without limitation, the Works, Plant, Materials, and Equipment, which are not Procuring Entity's risks are Contractor's risks.
C. Execution of the Facilities		
35. Representatives: Project Manager	35.1	If the Project Manager is not named in the Contract, then within fourteen (14) days of the Effective Date, the Procuring Entity shall appoint and notify the Contractor in writing of the name of the Project Manager. The Procuring Entity may from time to time appoint some other person as the Project Manager in place of the person previously so appointed, and shall give a notice of the name of such other person to the Contractor without delay. No such appointment shall be made at such a time or in such a manner as to impede the progress of work on the Facilities. Such appointment shall only take effect upon receipt of such notice by the Contractor. The Project Manager shall represent and act for the Procuring Entity at all times during the performance of the Contract. All notices, instructions, orders, certificates, approvals and all other communications under the Contract shall be given by the Project Manager, except as herein otherwise provided.

	35.2	All notices, instructions, information and other communications given by the Contractor to the Procuring Entity under the Contract shall be given to the Project Manager, except as herein otherwise provided.
36. Representatives: Contractor's Representative & Construction Manager	36.1	1If the Contractor's Representative is not named in the Contract fourteen (14) days, the Contractor's Representative shall be deemed to have been approved. If the Procuring Entity objects to the appointment within fourteen (14) days giving the reason therefor, then the Contractor shall appoint a replacement within fourteen (14) days of such objection, and the foregoing provisions of this GCC Sub-Clause 39.2.1 shall apply thereto.
	36.2	The Contractor's Representative shall represent and act for the Contractor at all times during the performance of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information and all other communications under the Contract. The Contractor shall not revoke the appointment of the Contractor's Representative without the Procuring Entity's prior written consent, which shall not be unreasonably withheld. If the Procuring Entity consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in GCC Sub-Clause 39.2.1.
	36.3	The Contractor's Representative may, subject to the approval of the Procuring Entity which shall not be unreasonably withheld, at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Procuring Entity and the Project Manager. Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Sub-Clause 39.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.
	36.4	From the commencement of installation of the Facilities at the Site until Completion, the Contractor's Representative shall appoint a suitable person as the Construction Manager. The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as the Construction Manager's deputy.

	36.5	The Procuring Entity may by notice to the Contractor object to a under GCC Sub-Clause 40.4. The Procuring Entity shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.
	36.6	If any representative or person employed by the Contractor is removed in accordance with GCC Sub-Clause 36.5, the Contractor shall, where required, promptly appoint a replacement.
37. Work Program	37.1	<u>Contractor's Organization</u> The Contractor shall supply to the Procuring Entity and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities within twenty-one (21) days of the Effective Date. The chart shall include the identities of the key personnel and the curricula vitae of such key personnel to be employed shall be supplied together with the chart. The Contractor shall promptly inform the Procuring Entity and the Project Manager in writing of any revision or alteration of such an organization chart.
	37.2	<u>Program of Performance</u> Within twenty-eight (28) days after the Effective Date, the Contractor shall submit to the Project Manager a detailed program of performance of the Contract, made in a form acceptable to the Project Manager and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and Pre Commission the Facilities, as well as the date by which the Contractor reasonably requires that the Procuring Entity shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion, Commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in the Appendix to the Contract Agreement titled Time Schedule, and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without modification in the Times for Completion specified in the PCC pursuant to Sub-Clause 29.1 and any extension granted in accordance with GCC Clause 70.2, and shall submit all such revisions to the Project Manager.
	37.3	<u>Progress Report</u> The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Sub-Clause 31.2 above, and supply a progress report to the Project Manager every month. The progress report shall be in a form acceptable to the Project Manager and shall indicate: (a) percentage completion achieved compared with the planned percentage completion

		for each activity; and (b) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken.
	37.4	<u>Progress of Performance</u> If at any time the Contractor's actual progress falls behind the program referred to in GCC Sub-Clause 37.2, or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Procuring Entity or the Project Manager, prepare and submit to the Project Manager a revised program, taking into account the prevailing circumstances, and shall notify the Project Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under GCC Sub-Clause 29.1, any extension thereof entitled under GCC Sub-Clause 70.1, or any extended period as may otherwise be agreed upon between the Procuring Entity and the Contractor.
	37.5	<u>Procedures</u> The Contract shall be executed in accordance with the Contract Documents including the procedures given in the Forms and Procedures of the Procuring Entity's Requirements. The Contractor may execute the Contract in accordance with its own standard project execution plans and procedures to the extent that they do not conflict with the provisions contained in the Contract.
38. Design and Engineering	38.1	<u>Specifications and Drawings</u> (a) The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice. The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Project Manager or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Procuring Entity. (b) The Contractor shall be entitled to disclaim responsibility for any design, data, drawing, specification or other document, or any modification thereof provided or designated by or on behalf of the Procuring Entity, by giving a notice of such disclaimer to the Project Manager.
	38.2	<u>Codes and Standards</u> Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of tender submission shall apply unless otherwise

		specified. During Contract execution, any changes in such codes and standards shall be applied subject to approval by the Procuring Entity and shall be treated in accordance with GCC Clause 69.
	38.3	<u>Approval/Review of Technical Documents by Project Manager</u> 38.3.1 The Contractor shall prepare or cause its Subcontractors to prepare, and furnish to the Project Manager the documents listed in the Appendix to the Contract Agreement titled List of Documents for Approval or Review, for its approval or review as specified and in accordance with the requirements of GCC Sub-Clause 37.2 (Program of Performance). Any part of the Facilities covered by or related to the documents to be approved by the Project Manager shall be executed only after the Project Manager's approval thereof. GCC Sub-Clauses 38.3.2 through 38.3.6 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only 38.3.2 Within fourteen (14) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Sub-Clause 38.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefor and the modifications that the Project Manager proposes. If the Project Manager fails to take such action within the said fourteen (14) days, then the said document shall be deemed to have been approved by the Project Manager. 38.3.3. The Project Manager shall not disapprove any document, except on the grounds that the document does not comply with the Contract or that it is contrary to good engineering practice. 38.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with GCC Sub-Clause 38.3.2. If the Project Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), whereupon the document shall be deemed to have been approved. 38.3.5 The Project Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any

		subsequent failure results from modifications required by the Project Manager. 38.3.6 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this GCC Sub-Clause 38.3. If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 70 shall apply to such request.
39. Procurement	39.1	<u>Plant</u> Subject to GCC Sub-Clause 65.2, the Contractor shall procure and transport all Plant in an expeditious and orderly manner to the Site.
	39.2	<u>Procuring Entity-Supplied Plant</u> If the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity, provides that the Procuring Entity shall furnish any specific items to the Contractor, the following provisions shall apply: i. The Procuring Entity shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the Parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to GCC Sub-Clause 37.2, unless otherwise mutually agreed. ii. Upon receipt of such item, the Contractor shall inspect the same visually and notify the Project Manager of any detected shortage, defect or default. The Procuring Entity shall immediately remedy any shortage, defect or default, or the Contractor shall, if practicable and possible, at the request of the Procuring Entity, remedy such shortage, defect or default at the Procuring Entity's cost and expense. After inspection, such item shall fall under the care, custody and control of the Contractor. The provision of this GCC Sub-Clause 39.2.ii. shall apply to any item supplied to remedy any such shortage or default or to substitute for any defective item, or shall apply to defective items that have been repaired. iii. The foregoing responsibilities of the Contractor and its obligations of care, custody and control shall not relieve the Procuring Entity of liability for any undetected shortage, defect or default, nor place the Contractor under any liability for any such shortage, defect or default whether under GCC Clause 45 or under any other provision of Contract.
	39.3	<u>Transportation</u> i. The Contractor shall at its own risk and expense transport all the materials and the Contractor's

		Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances. ii. Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the materials and the Contractor's Equipment. iii. Upon dispatch of each shipment of materials and the Contractor's Equipment, the Contractor shall notify the Procuring Entity by telex, cable, facsimile or electronic means, of the description of the materials and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Procuring Entity with relevant shipping documents to be agreed upon between the Parties. iv. The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the materials and the Contractor's Equipment to the Site. The Procuring Entity shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Procuring Entity from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the materials and the Contractor's Equipment to the Site.
	39.4	<u>Customs Clearance</u> The Contractor shall, at its own expense, handle all imported materials and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance, subject to the Procuring Entity's obligations under GCC Sub-Clause 65.2, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Procuring Entity, the Procuring Entity shall take all necessary steps to comply with such laws or regulations. In the event of delays in customs clearance that are not the fault of the Contractor, the Contractor shall be entitled to an extension in the Time for Completion, pursuant to GCC Clause 70.
40. Installation	40.1	<u>Setting Out/Supervision</u> i. Bench Mark: The Contractor shall be responsible for the true and proper setting-out of the Facilities in relation to bench marks, reference marks and lines provided to it in writing by or on behalf of the Procuring Entity. If, at any time during the progress of installation of the

		Facilities, any error shall appear in the position, level or alignment of the Facilities, the Contractor shall forthwith notify the Project Manager of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Project Manager. If such error is based on incorrect data provided in writing by or on behalf of the Procuring Entity, the expense of rectifying the same shall be borne by the Procuring Entity. ii. Contractor's Supervision: The Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand.
	40.2	Labor: 40.2.1 Engagement of Staff and Labor (a) Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labor, local or otherwise, and for their payment, housing, feeding and transport. (b) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills. (c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located. The Procuring Entity will, if requested by the Contractor, use his best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national or government permission required for bringing in the Contractor's personnel. (d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to the place where they were

		recruited or to their domicile. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Procuring Entity may provide the same to such personnel and recover the cost of doing so from the Contractor. 40.2.2 Persons in the Service of Procuring Entity The Contractor shall not recruit, or attempt to recruit, staff and labor from amongst the Procuring Entity's Personnel. 40.2.3 Facilities for Staff and Labor Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Procuring Entity's Personnel as stated in the Specification. The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.
	40.3	<u>Contractor's Equipment</u> 40.3.1 All Contractor's Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Project Manager's consent that such Contractor's Equipment is no longer required for the execution of the Contract. 40.3.2 Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon. 40.3.3 The Procuring Entity will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract.

	40.4	<u>Site Regulations and Safety</u> The Procuring Entity and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Procuring Entity, with a copy to the Project Manager, proposed Site regulations for the Procuring Entity's approval, which approval shall not be unreasonably withheld. Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Facilities, gate control, sanitation, medical care, and fire prevention. reasonable costs incurred by the Procuring Entity in connection therewith shall be paid by the Contractor to the Procuring Entity. Otherwise, the cost of such remedial work shall be borne by the Procuring Entity.
	40.5	<u>Site Clearance</u> Site Clearance in Course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.
	40.6	<u>Opportunities for Other Contractors</u> 40.6.1 The Contractor shall, upon written request from the Procuring Entity or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Procuring Entity on or near the Site. 40.6.2 If the Contractor, upon written request from the Procuring Entity or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Procuring Entity shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.
	40.7	<u>Emergency Work</u> 40.7.1 If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall

		immediately carry out such work. If the Contractor is unable or unwilling to do such work immediately, the Procuring Entity may do or cause such work to be done as the Procuring Entity may determine is necessary in order to prevent damage to the Facilities. In such event the Procuring Entity shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Procuring Entity is work that the Contractor was liable to do at its own expense under the Contract. 40.7.2 Clearance of Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities in a clean and safe condition.
	40.8	<u>Watching and Lighting</u> The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.
41. Test & Inspection	41.1	The Contractor shall at its own expense carry out at the place of manufacture and/or on the Site all such tests and/or inspections of the Plant and any part of the Facilities as are specified in the Contract.
	41.2	The Procuring Entity and the Project Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the Procuring Entity shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and board and lodging expenses.
	41.3	Whenever the Contractor is ready to carry out any such test and/or inspection, the Contractor shall give a reasonable advance notice of such test and/or inspection and of the place and time thereof to the Project Manager. The Contractor shall obtain from any relevant third Party or manufacturer any necessary permission or consent to enable the Procuring Entity and the Project Manager or their designated representatives to attend the test and/or inspection.
	41.4	The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection. If the Procuring Entity or Project Manager or their designated representatives fails to attend the test and/or

		inspection, or if it is agreed between the Parties that such persons shall not do so, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Project Manager with a certified report of the results thereof.
	41.5	The Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impede the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.
	41.6	If any Plant or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under GCC Sub-Clause 41.3.
	41.7	If any dispute or difference of opinion shall arise between the Parties in connection with or arising out of the test and/or inspection of the Plant or part of the Facilities that cannot be settled between the Parties within a reasonable period of time, it may be referred to an 82.3.
	41.8	The Contractor shall afford the Procuring Entity and the Project Manager, at the Procuring Entity's expense, access at any reasonable time to any place where the Plant are being manufactured or the Facilities are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Project Manager shall give the Contractor a reasonable prior notice.
	41.9	The Contractor agrees that neither the execution of a test and/or inspection of Plant or any part of the Facilities, nor the attendance by the Procuring Entity or the Project Manager, nor the issue of any test certificate pursuant to GCC Sub-Clause 41.4, shall release the Contractor from any other responsibilities under the Contract.
	41.10	No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any test and/or inspection required under the Contract. The Contractor shall give a reasonable notice to the Project Manager whenever any such parts of the Facilities or foundations are ready or about to be ready for test and/or inspection; such test and/or inspection and notice thereof shall be subject to the requirements of the Contract.

	41.11	The Contractor shall uncover any part of the Facilities or foundations, or shall make openings in or through the same as the Project Manager may from time to time require at the Site, and shall reinstate and make good such part or parts.
	41.12	If any parts of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Sub-Clause 41.10 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Procuring Entity, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.
42. Completion of the Facilities	42.1	As soon as the Facilities or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Procuring Entity's Requirements, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Procuring Entity in writing.
	42.2	Within seven (7) days after receipt of the notice from the Contractor under GCC Sub-Clause 42.1, the Procuring Entity shall supply the operating and maintenance personnel specified in the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity for Pre-Commissioning of the Facilities or any part thereof. Pursuant to the Appendix to the Contract Agreement titled Scope of Works and Supply by the Procuring Entity, the Procuring Entity shall also provide, within the said seven (7) day period, the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Pre-Commissioning of the Facilities or any part thereof.
	42.3	As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Procuring Entity and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters have been provided by the Procuring Entity in accordance with GCC Sub-Clause 42.2, the Contractor shall commence Pre-commissioning of the Facilities or the relevant part thereof in preparation for Commissioning, subject to GCC Sub-Clause 43.5.
	42.4	The Project Manager shall, within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 39.4, either issue a Completion Certificate in the form specified in the Procuring Entity's Requirements (Forms and Procedures), stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's notice, or notify the Contractor in writing of any defects and/or deficiencies. If the Project Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such

		defects and/or deficiencies, and shall repeat the procedure.
	42.5	If the Project Manager is satisfied that the Facilities or that part thereof have reached Completion, the Project Manager shall, within seven (7) days after receipt of the Contractor's repeated notice, issue a Completion Certificate stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's repeated notice.
	42.6	If the Project Manager is not so satisfied, then it shall notify the Contractor in writing of any defects and/or deficiencies within seven (7) days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated.
	42.7	If the Project Manager fails to issue the Completion Certificate and fails to inform the Contractor of any defects and/or deficiencies within fourteen (14) days after receipt of the Contractor's notice or within seven (7) days after receipt of the Contractor's repeated notice under GCC Sub-Clause 42.4, or if the Procuring Entity makes use of the Facilities or part thereof, then the Facilities or that part thereof shall be deemed to have reached Completion as of the date of the Contractor's notice or repeated notice, or as of the Procuring Entity's use of the Facilities, as the case may be.
	42.8	As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the Contract, failing which the Procuring Entity will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.
	42.9	Upon Completion, the Procuring Entity shall be responsible for the care and custody of the Facilities or the relevant part thereof, together with the risk of loss or damage thereto, and shall thereafter take over the Facilities or the relevant part thereof.
43. Commissioning and Operational Acceptance	43.1	<u>Commissioning</u> 43.1.1 Commissioning of the Facilities or any part thereof shall be commenced by the Contractor immediately after issue of the Completion Certificate by the Project Manager, pursuant to GCC Sub-Clause 42.4, or immediately after the date of the deemed Completion, under GCC Sub-Clause 42.5. 43.1.2 The Procuring Entity shall supply the operating and maintenance personnel and all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Commissioning. 43.1.3 In accordance with the requirements of the Contract, the Contractor's and Project Manager's advisory personnel shall attend the Commissioning, including the Guarantee Test, and shall advise and assist the

		Procuring Entity.
	43.2	Guarantee Test 43.2.1 Subject to GCC Sub-Clause 43.5, the Guarantee Test and repeats thereof shall be conducted by the Contractor during Commissioning of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Appendix to the Contract Agreement titled Functional Guarantees. The Procuring Entity shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test and any repeats thereof. 43.2.2 If for reasons not attributable to the Contractor, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the period from the date of Completion specified in the PCC or any other period agreed upon by the Procuring Entity and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and GCC Sub-Clauses 46.2 and 46.3 shall not apply.
	43.3	Operational Acceptance 43.3.1 The Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Procuring Entity's Requirements (Forms and Procedures) in respect of the Facilities or the part thereof specified in such notice as of the date of such notice. 43.3.2 The Project Manager shall, after consultation with the Procuring Entity, and within seven (7) days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate. 43.3.3 If within seven (7) days after receipt of the Contractor's notice, the Project Manager fails to issue the Operational Acceptance Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Operational Acceptance Certificate, the Facilities or the relevant part thereof shall be deemed to have been accepted as of the date of the Contractor's said notice.
	43.4	<u>Partial Acceptance</u> 43.4.1 If the Contract specifies that Completion and Commissioning shall be carried out in respect of parts of the Facilities, the provisions relating to Completion and Commissioning including the Guarantee Test shall

		apply to each such part of the Facilities individually, and the Operational Acceptance Certificate shall be issued accordingly for each such part of the Facilities. 43.4 If a part of the Facilities comprises facilities such as buildings, for which no Commissioning or Guarantee Test is required, then the Project Manager shall issue the Operational Acceptance Certificate for such facility when it attains Completion, provided that the Contractor shall thereafter complete any outstanding minor items that are listed in the Operational Acceptance Certificate.
	43.5	<u>Delayed Pre-commissioning and/or Guarantee Test</u> 43.5.1 In the event that the Contractor is unable to proceed with the Pre-commissioning of the Facilities pursuant to Sub-Clause 42.3, or with the Guarantee Test pursuant to Sub-Clause 43.2, for reasons attributable to the Procuring Entity either on account of non-availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Contractor's control, the provisions leading to "deemed" completion of activities such as Completion, pursuant to GCC Sub-Clause 42.6, and Operational Acceptance, pursuant to GCC Sub-Clause 43.3.3, and Contractor's obligations regarding Defect Liability Period, pursuant to GCC Sub-Clause 45.2, Functional Guarantee, pursuant to GCC Clause 46, and Care of Facilities, pursuant to GCC Clause 50, and GCC Clause 71.1, Suspension, shall not apply. In this case, the following provisions shall apply. 43.5.2 When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to clauses 62, 63 & 64, the Contractor shall be entitled to the following: (a) the Time of Completion shall be extended for the period of suspension without imposition of liquidated damages pursuant to GCC Sub-Clause 44.2; (b) payments due to the Contractor in accordance with the provision specified in the Appendix to the Contract Agreement titled Terms and Procedures of Payment, which would not have been payable in normal circumstances due to non-completion of the subject activities, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Procuring Entity, and which shall become null and void when the Contractor will have complied with its obligations regarding those payments, subject to the provision of Sub-Clause 43.5.3 below; (c) the expenses towards the above security and

		extension of other securities under the contract, of which validity needs to be extended, shall be reimbursed to the Contractor by the Procuring Entity; (d) the additional charges towards the care of the Facilities pursuant to GCC Sub-Clause 50.1 shall be reimbursed to the Contractor by the Procuring Entity for the period between the notification mentioned above and the notification mentioned in Sub-Clause 43.5.4 below. The provision of GCC Sub-Clause 49.2 shall apply to the Facilities during the same period. 43.5.3 In the event that the period of suspension under above Sub-Clause 43.5.1 actually exceeds one hundred eighty (180) days, the Procuring Entity and Contractor shall mutually agree to any additional compensation payable to the Contractor. 43.5.4 When the Contractor is notified by the Project Manager that the plant is ready for Pre-commissioning, the Contractor shall proceed without delay in performing Pre-commissioning, in accordance with Clause 42.

D. Guarantees and Liabilities		
44. Completion Time Guarantee	44.1	The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified) within the Time for Completion specified in the PCC pursuant to GCC Sub-Clause 29.1, or within such extended time to which the Contractor shall be entitled under GCC Clause 70 hereof.
	44.2	If the Contractor fails to attain Completion of the Facilities or any part thereof within the Time for Completion or any extension thereof under GCC Clause 70, the Contractor shall pay to the Procuring Entity liquidated damages in the amount specified in the PCC as a percentage rate of the Contract Price or the relevant part thereof. The aggregate amount of such liquidated damages shall in no event exceed the amount specified as “Maximum” in the PCC as a percentage rate of the Contract Price. Once the “Maximum” is reached, the Procuring Entity may consider termination of the Contract, pursuant to GCC Sub-Clause 73.1. Such payment shall completely satisfy the Contractor’s obligation to attain Completion of the Facilities or the relevant part thereof within the Time for Completion or any extension thereof under GCC Clause 70. The Contractor shall have no further liability whatsoever to the Procuring Entity in respect thereof. However, the payment of liquidated damages shall not in any way relieve the Contractor from any of its obligations to complete the Facilities or from any other obligations and liabilities of the Contractor under the Contract. Save for liquidated damages payable under this GCC Sub-Clause 44.2, the failure by the Contractor to attain any milestone or other act, matter or thing by any date specified in the Appendix to the Contract Agreement titled Time Schedule, and/or other program of work prepared pursuant to GCC Sub-Clause 37.2 shall not render the Contractor liable for any loss or damage thereby suffered by the Procuring Entity.
	44.3	If the Contractor attains Completion of the Facilities or any part thereof before the Time for Completion or any extension thereof under GCC Clause 70, the Procuring Entity shall pay to the Contractor a bonus in the amount specified in the PCC . The aggregate amount of such bonus shall in no event exceed the amount specified as “Maximum” in the PCC .
	44.3	
45. Defect Liability	45.1	The Contractor warrants that the Facilities or any part thereof shall be free from defects in the design, engineering, materials and workmanship of the Plant supplied and of the work executed.
	45.2	The Defect Liability Period shall be five hundred and forty (540) days from the date of Completion of the Facilities (or any part thereof) or one year from the date of Operational Acceptance of the Facilities (or any part thereof), whichever first occurs, unless specified otherwise in the PCC pursuant to GCC Sub-Clause 45.10. If during the Defect Liability Period any defect should be found

		in the design, engineering, materials and workmanship of the Plant supplied or of the work executed by the Contractor, the Contractor shall promptly, in consultation and agreement with the Procuring Entity regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good as the Contractor shall determine at its discretion, such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes: (a) improper operation or maintenance of the Facilities by the Procuring Entity; (b) operation of the Facilities outside specifications provided in the Contract; or (c) Normal wear and tear.
	45.3	The Contractor's obligations under this GCC Clause 45 shall not apply to: (a) any materials that are supplied by the Procuring Entity under GCC Sub-Clause 39.2, are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein; (b) any designs, specifications or other data designed, supplied or specified by or on behalf of the Procuring Entity or any matters for which the Contractor has disclaimed responsibility herein; or (c) Any other materials supplied or any other work executed by or on behalf of the Procuring Entity, except for the work executed by the Procuring Entity under GCC Sub-Clause 45.7.
	45.4	The Procuring Entity shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Procuring Entity shall afford all reasonable opportunity for the Contractor to inspect any such defect.
	45.5	The Procuring Entity shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this GCC Clause 45. The Contractor may, with the consent of the Procuring Entity, remove from the Site any Plant or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.
	45.6	If the repair, replacement or making good is of such a character that it may affect the efficiency of the Facilities or any part thereof, the Procuring Entity may give to the Contractor a notice requiring that tests of the defective part of the Facilities

		shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests. If such part fails the tests, the Contractor shall carry out further repair, replacement or making good, as the case may be, until that part of the Facilities passes such tests. The tests shall be agreed upon by the Procuring Entity and the Contractor.
	45.7	If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Procuring Entity may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Procuring Entity in connection therewith shall be paid to the Procuring Entity by the Contractor or may be deducted by the Procuring Entity from any monies due the Contractor or claimed under the Performance Security.
	45.8	If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Procuring Entity because of any of the aforesaid reasons.
	45.9	Except as provided in GCC Clauses 45 and 52, the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant, design or engineering or work executed that appear after Completion of the Facilities or any part thereof, except where such defects are the result of the gross negligence, fraud, or criminal or willful action of the Contractor.
	45.10	In addition, any such component of the Facilities, and during the period of time as may be specified in the PCC , shall be subject to an extended defect liability period. Such obligation of the Contractor shall be in addition to the defect liability period specified under GCC Sub-Clause 45.2.
46. Functional Guarantees	46.1	The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees specified in the Appendix to the Contract Agreement titled Functional Guarantees, subject to and upon the conditions therein specified.
	46.2	If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in the Appendix to the Contract Agreement titled Functional Guarantees, are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet at least the minimum level of such Guarantees. The

		Contractor shall notify the Procuring Entity upon completion of the necessary changes, modifications and/or additions, and shall request the Procuring Entity to repeat the Guarantee Test until the minimum level of the Guarantees has been met. If the Contractor eventually fails to meet the minimum level of Functional Guarantees, the Procuring Entity may consider termination of the Contract, pursuant to GCC Sub-Clause 69.2.2.
	46.3	If, for reasons attributable to the Contractor, the Functional Guarantees specified in the Appendix to the Contract Agreement titled Functional Guarantees, are not attained either in whole or in part, but the minimum level of the Functional Guarantees specified in the said Appendix to the Contract Agreement is met, the Contractor shall, at the Contractor's option, either (a) make such changes, modifications and/or additions to the Facilities or any part thereof that are necessary to attain the Functional Guarantees at its cost and expense, and shall request the Procuring Entity to repeat the Guarantee Test or (b) pay liquidated damages to the Procuring Entity in respect of the failure to meet the Functional Guarantees in accordance with the provisions in the Appendix to the Contract Agreement titled Functional Guarantees.
	46.4	The payment of liquidated damages under GCC Sub-Clause 46.3, up to the limitation of liability specified in the Appendix to the Contract Agreement titled Functional Guarantees, shall completely satisfy the Contractor's guarantees under GCC Sub-Clause 46.3, and the Contractor shall have no further liability whatsoever to the Procuring Entity in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid.
47. Patent Indemnity	47.1	The Contractor shall, subject to the Procuring Entity's compliance with GCC Sub-Clause 47.2, indemnify and hold harmless the Procuring Entity and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Procuring Entity may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country. Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be

		reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract Agreement.
	47.2	If any proceedings are brought or any claim is made against the Procuring Entity arising out of the matters referred to in GCC Sub-Clause 34.1, the Procuring Entity shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Procuring Entity's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify the Procuring Entity within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Procuring Entity shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Procuring Entity within the twenty-eight (28) day period, the Procuring Entity shall make no admission that may be prejudicial to the defense of any such proceedings or claim. The Procuring Entity shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
	47.3	The Procuring Entity shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Procuring Entity.
48. Limitation of Liability	48.1	Except in cases of criminal negligence or willful misconduct, (a) neither Party shall be liable to the other Party, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, which may be suffered by the other Party in connection with the Contract, other than specifically provided as any obligation of the Party in the Contract, and (b) the aggregate liability of the Contractor to the Procuring Entity, whether under the Contract, in tort or otherwise, shall not exceed the amount resulting from the application of the multiplier specified in the PCC, to the Contract Price or, if a multiplier is not so specified, the total Contract Price, provided that this limitation

		shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the Contractor to indemnify the Procuring Entity with respect to patent infringement..
E. Risk Distribution		
49. Transfer of Ownership	49.1	Ownership of the Plant (including spare parts) to be imported into the country where the Site is located shall be transferred to the Procuring Entity upon loading on to the mode of transport to be used to convey the Plant from the country of origin to that country.
	49.2	Ownership of the Plant (including spare parts) procured in the country where the Site is located shall be transferred to the Procuring Entity when the Plant are brought on to the Site.
	49.3	Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.
	49.4	Ownership of any Plant in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when the Procuring Entity and the Contractor agree that the Plant in question are no longer required for the Facilities.
	49.5	Notwithstanding the transfer of ownership of the Plant, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to GCC Clause 50 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant are incorporated.
50. Care of Facilities	50.1	The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to GCC Clause 42 or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out, pursuant to GCC Clause 45. Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clauses 50.2.

	50.2	If any loss or damage occurs to the Facilities or any part thereof or to the Contractor's temporary facilities by reason of (a) insofar as they relate to the country where the Site is located, nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable on the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under GCC Clause 17 hereof; or (b) any use or occupation by the Procuring Entity or any third Party other than a Subcontractor, authorized by the Procuring Entity of any part of the Facilities; or (c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of the Procuring Entity, or any such matter for which the Contractor has disclaimed responsibility herein,
	50.3	the Procuring Entity shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed or damaged. If the Procuring Entity requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Procuring Entity in accordance with GCC Clause 64. If the Procuring Entity does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Procuring Entity shall either request a change in accordance with GCC Clause 69, excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Procuring Entity shall terminate the Contract pursuant to GCC Sub-Clause 71.1 hereof.
	50.4	The Contractor shall be liable for any loss of or damage to any Contractor's Equipment, or any other property of the Contractor used or intended to be used for purposes of the Facilities, except (i) as mentioned in GCC Sub-Clause 45.2 with respect to the Contractor's temporary facilities, and (ii) where such loss or damage arises by reason of any of the matters specified in GCC Sub-Clauses 50.2 (b) and (c).
51. Loss of or Damage to Property; Accident or Injury to Workers; Indemnification	51.1	Subject to GCC Sub-Clause 51.3, the Contractor shall indemnify and hold harmless the Procuring Entity and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person

		or loss of or damage to any property other than the Facilities whether accepted or not, arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of the Procuring Entity, its contractors, employees, officers or agents.
	51.2	If any proceedings are brought or any claim is made against the Procuring Entity that might subject the Contractor to liability under GCC Sub-Clause 51.1, the Procuring Entity shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Procuring Entity's, name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.
	51.3	If the Contractor fails to notify the Procuring Entity within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Procuring Entity shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Procuring Entity within the twenty-eight (28) day period, the Procuring Entity shall make no admission that may be prejudicial to the defense of any such proceedings or claim. The Procuring Entity shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
	51.4	The Procuring Entity shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from any liability for loss of or damage to property of the Procuring Entity, other than the Facilities not yet taken over, that is caused by fire, explosion or any other perils, in excess of the amount recoverable from insurances procured under GCC Clause 52, provided that such fire, explosion or other perils were not caused by any act or failure of the Contractor.
	51.5	The Party entitled to the benefit of an indemnity under this GCC Clause 51 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the Party fails to take such measures, the other Party's liabilities shall be correspondingly reduced.
52. Insurance	52.1	To the extent specified in the Appendix and in PCC to the Contract Agreement titled Insurance Requirements, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of the Procuring Entity, who should not unreasonably withhold such approval. (a) <u>Cargo Insurance During Transport</u>

		Covering loss or damage occurring while in transit from the Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant (including spare parts therefor) and to the Contractor's Equipment. (b) <u>Installation All Risks Insurance</u> Covering physical loss or damage to the Facilities at the Site, occurring prior to Completion of the Facilities, with extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period. (c) <u>Third Party Liability Insurance</u> Covering bodily injury or death suffered by third Parties including the Procuring Entity's personnel, and loss of or damage to property occurring in connection with the supply and installation of the Facilities. (d) <u>Automobile Liability Insurance</u> Covering use of all vehicles used by the Contractor or its Subcontractors, whether or not owned by them, in connection with the execution of the Contract. (e) <u>Workers' Compensation</u> In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed. (f) <u>Procuring Entity's Liability</u> In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed. (g) <u>Other Insurances</u> Such other insurances as may be specifically agreed upon by the Parties hereto as listed in the Appendix to the Contract Agreement titled Insurance Requirements.
	52.2	The Procuring Entity shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 52.1, except for the Third Party Liability, Workers' Compensation and Procuring Entity's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 52.1 except for the Cargo Insurance during Transportation, Workers' Compensation and Procuring Entity's Liability Insurances. All insurer's rights of

		subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.
	52.3	The Contractor shall, in accordance with the provisions of the Appendix to the Contract Agreement titled Insurance Requirements, deliver to the Procuring Entity certificates of insurance or copies of the insurance policies as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) days' notice shall be given to the Procuring Entity by insurers prior to cancellation or material modification of a policy.
	52.4	The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor.
	52.5	The Procuring Entity shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in the Appendix to the Contract Agreement titled Insurance Requirements, in the sums and with the deductibles and other conditions specified in the said Appendix. The Contractor and the Contractor's Subcontractors shall be named as co-insured under all such policies. All insurers' rights of subrogation against such co-insured for losses or claims arising out of the performance of the Contract shall be waived under such policies. The Procuring Entity shall deliver to the Contractor satisfactory evidence that the required insurances are in full force and effect. The policies shall provide that not less than twenty-one (21) days' notice shall be given to the Contractor by all insurers prior to any cancellation or material modification of the policies. If so requested by the Contractor, the Procuring Entity shall provide copies of the policies taken out by the Procuring Entity under this GCC Sub-Clause 52.5.
	52.6	If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Sub-Clause 51.1, the Procuring Entity may take out and maintain in effect any such insurances and may from time to time deduct from any amount due to the Contractor under the Contract any premium that the Procuring Entity shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Procuring Entity fails to take out and/or maintain in effect the insurances referred to in GCC 49.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Procuring Entity under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Procuring Entity. If the Contractor fails to or is unable to take out and maintain in effect any such insurances, the Contractor shall nevertheless have no liability or responsibility towards the Procuring Entity, and the

		Contractor shall have full recourse against the Procuring Entity for any and all liabilities of the Procuring Entity herein.
	52.7	Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies affected by it pursuant to this GCC Clause 52, and all monies payable by any insurers shall be paid to the Contractor. The Procuring Entity shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Procuring Entity's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of the Procuring Entity. With respect to insurance claims in which the Contractor's interest is involved, the Procuring Entity shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.

53. Limitation of Liability	53.1	Except in cases of criminal negligence or wilful misconduct, (a) the Contractor shall not be liable to the Procuring Entity, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Procuring Entity; and (b) the aggregate liability of the Contractor to the Procuring Entity, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the Contractor to indemnify the Procuring Entity with respect to patent infringement.
54. Unforeseen Conditions	54.1	If, during the execution of the Contract, the Contractor shall encounter on the Site any physical conditions other than climatic conditions, or artificial obstructions that could not have been reasonably foreseen prior to the date of the Contract Agreement by an experienced contractor on the basis of reasonable examination of the data relating to the Facilities including any data as to boring tests, provided by the Procuring Entity, and on the basis of information that it could have obtained from a visual inspection of the Site if access thereto was available, or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall

		promptly, and before performing additional work or using additional Plant or Contractor's Equipment, notify the Project Manager in writing beforehand: (a) the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen; (b) the additional work and/or Plant and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions; (c) the extent of the anticipated delay; and (d) the additional cost and expense that the Contractor is likely to incur.) On receiving any notice from the Contractor under this GCC Sub-Clause 54.1, the Project Manager shall promptly consult with the Procuring Entity and Contractor and decide upon the actions to be taken to overcome the physical conditions or artificial obstructions encountered. Following such consultations, the Project Manager shall instruct the Contractor, with a copy to the Procuring Entity, of the actions to be taken.
	54.2	Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in GCC Sub-Clause 54.1 shall be paid by the Procuring Entity to the Contractor as an addition to the Contract Price.
	54.3	If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in GCC Sub-Clause 54.1, the Time for Completion shall be extended in accordance with GCC Clause 65.
55. Adjustment for Changes in Legislation	55.1	Unless otherwise specified in the Contract, if after the Contract, any law, regulation, ordinance, order or by law having the force of law is enacted, promulgated, abrogated, or changed in Bangladesh (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the Delivery Date and/or the Contract Price, then such Delivery Date and/or Contract Price shall be correspondingly increased or decreased, to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract.
56. Force Majeure	56.1	Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below: (i) war, hostilities (whether war be declared or not), invasion, act of foreign enemies;

		(ii) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war; (iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel; (iv) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, and (v) natural catastrophes such as cyclone, hurricane, typhoon, tsunami, storm surge, floods, earthquake, landslides, fires, epidemics, quarantine restrictions, or volcanic activity; (vi) freight embargoes; (vii) acts of the Government in its sovereign capacity.
	56.2	The Head of Procuring Entity decides the existence of a Force Majeure that will be the basis of the issuance of order for suspension of Supply as stated under GCC Sub Clause 59.2.
57. Notice of Force Majeure	57.1	If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice within fourteen (14) days after the party became aware, to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented.
	57.2	Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.
58. Duty to Minimise Delay	58.1	Each Party shall at all times use all reasonable endeavours to minimise any delay in the performance of the Contract as a result of Force Majeure.
	58.2	A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.
59. Consequences of Force Majeure	59.1	The Contractor shall not be liable for forfeiture of its security, liquidated damages, or termination for default if and to the extent that its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure
	59.2	The Procuring Entity may suspend the delivery or contract implementation, wholly or partly, by written order for a certain period of time, as it deems necessary due to Force Majeure as defined in the Contract.
	59.3	Delivery shall be made either upon the lifting or the expiration of the suspension order. However, if the Procuring Entity terminates the contract as stated under GCC Clause 59, resumption of delivery cannot be done.

	59.4	After receiving notice under GCC Sub Clause 57.1, the Procuring Entity shall proceed to determine these matters under the provisions of the Contract.
F. Payment		
60. Contract Price	60.1	The Contract Price shall be paid as specified in the Contract Agreement Form PG5A- 8.
	60.2	Unless an adjustment clause is provided for in the PCC , the Contract Price shall be a firm lump sum not subject to any alteration, except in the event of a Change in the Facilities or as otherwise provided in the Contract.
	60.3	Subject to GCC Sub-Clauses 30.2, 31.1 and 54 hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.
	60.4	Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the PCC. If so provided, the amounts as certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amount. The generic formula indicated below in the form as specified in the PCC applies: $P = A + B (I_m / I_o)$ where: P is the adjustment factor A and B are Coefficients specified in the PCC, representing the nonadjustable and adjustable portions, respectively, of the Contract; and I_m is the Index during the month the work has been executed and I_o is the Index prevailing twenty-eight (28) days prior to the deadline for submission of Tender. The Indexes to be used is as published by the Bangladesh Bureau of Statistics (BBS) on a monthly basis. In case not available, then other countries or authorities of the sources mentioned in Appendix to the Tender may be used.
	60.5	If the value of the Index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next or in the final payment certificate. The Index value shall be deemed to take account of all changes in price due to fluctuations.
61. Terms of Payment	61.1	The Contract Price, including any Advance Payments specified in PCC , if applicable, shall be paid in the manner as specified in the PCC and in the Appendix to the Contract Agreement titled Terms and Procedures of Payment, which also outlines the procedures to be followed in making application for and processing payments.

	61.2	No payment made by the Procuring Entity herein shall be deemed to constitute acceptance by the Procuring Entity of the Facilities or any part(s) thereof.
	61.3	Payments shall be made promptly by the Procuring Entity after submission of an invoice or request for payment by the Contractor, and after the Procuring Entity has accepted it.
	61.4	The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in the Appendices to the Contract Agreement titled Terms and Procedures of Payment, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's tender.
	61.5	In the event that the Procuring Entity fails to pay the Contractor any payment by its respective due date or within the period as stated under GCC Sub Clause 61.3, the Procuring Entity shall pay to the Contractor interest on the amount of such delayed payment at the rate specified in the PCC , for the period of delay until payment has been made in full.
	61.6	If an amount certified is increased in a subsequent certificate as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.
62. Advance Payment Security	62.1	The Contractor shall, within twenty-eight (28) days of the notification of contract award, provide a security in an amount equal to the advance payment calculated in accordance with the Appendix to the Contract Agreement titled Terms and Procedures of Payment, and in the same currency or currencies.
	62.2	The security shall be in the form provided in the tender documents or in another form acceptable to the Procuring Entity. The amount of the security shall be reduced in proportion to the value of the Facilities executed by and paid to the Contractor from time to time, and shall automatically become null and void when the full amount of the advance payment has been recovered by the Procuring Entity. The security shall be returned to the Contractor immediately after its expiration.
63. Performance Security	63.1	The Procuring Entity shall notify the Contractor of any claim made against the Bank issuing the Performance Security. in the amount specified in the PCC .
	63.2	The Procuring Entity may claim against the security if any of the following events occurs for fourteen (14) days or more. i. The Contractor is in breach of the Contract and the Procuring Entity has duly notified him or her; and ii. The Contractor has not paid an amount due to the Procuring Entity and the Procuring Entity has duly notified him or her.
	63.3	In the event as stated under GCC Sub Clause 63.2, the Contractor is liable to pay compensation under the Contract amounting to the full value of the Performance Security or more, the Procuring Entity may call the full amount of the security.

	63.4	Unless otherwise specified in the PCC , the security shall be reduced by half on the date of the Operational Acceptance. The Security shall become null and void, or shall be reduced pro rata to the Contract Price of a part of the Facilities for which a separate Time for Completion is provided, five hundred and forty (540) days after Completion of the Facilities or three hundred and sixty five (365) days after Operational Acceptance of the Facilities, whichever occurs first; provided, however, that if the Defects Liability Period has been extended on any part of the Facilities pursuant to GCC Sub-Clause 45.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor, pursuant to GCC Sub-Clause 45.10, is liable for an extended defect liability obligation, the performance security shall be extended for the period specified in the PCC pursuant to GCC Sub-Clause 45.10 and up to the amount specified in the PCC.
	63.5	If there is no reason to call the security, the security shall be discharged by the Procuring Entity and returned to the Contractor not later than seven (7) days following the date of making the final payment to the Contractor under the Contract and subject to the issuance of the Acceptance Certificate by the Procuring Entity,
64. Retention Money	64.1	The Procuring Entity shall retain an amount from the payable amount due to the Contractor at the percentage specified in the PCC until successful expiration of the Defect Liability period.
	64.2	The total amount retained under GCC Sub Clause 64.1 shall be kept to meet any claims during the Defect Liability Period and shall be returned after the successful expiration of Defects Liability Period and the Project Manager has certified in the form of Defects Corrections Certificate .
65. Taxes and Duties	65.1	The Contractor shall be entirely responsible for all kinds of taxes, customs duties, VAT, fees, levies, and such other charges assessed on the Contractor, its Subcontractors or their employees by all municipal, state or national government authorities in connection with the Facilities in and outside of the country where the Site is located.
	65.2	Notwithstanding GCC Sub-Clause 65.1 above, the Procuring Entity shall bear and promptly pay (a) all customs and import duties for the Plant specified in Price Schedule No. 1; and (b) other domestic taxes such as, sales tax and value added tax (VAT) on the Plant specified in Price Schedules No. 1 and No. 2 and that is to be incorporated into the Facilities, and on the finished goods, imposed by the law of the country where the Site is located.
	65.3	In the event that the rate of any direct or indirect tax (including, but not limited to, income tax, VAT, customs duties, etc.) is altered by virtue of any law, regulation, order, or other legal instrument, the Contract Price shall, subject to the approval of the Head of the Procuring Entity, be adjusted (either upward or downward) so as to ensure that the net amount payable to the

		Contractor remains unaffected by such legal changes.
66. Payments to Nominated Subcontractor(s)	66.1	The Contractor shall pay to the Nominated Subcontractor(s) the amounts shown on the Nominated Subcontractor's invoices approved by the Contractor in accordance with the subcontract included under the Contract.
67. Price Adjustment	67.1	Where the Contract Period (excluding the Defects Liability Period) exceeds eighteen (18) months, it is normal procedure that prices payable to the Contractor shall be subject to adjustment during the performance of the Contract to reflect changes occurring in the cost of labour and material components. In such cases the tender documents shall include in the Appendix 2, a formula of such price adjustment.
	67.2	Where Contracts are of a shorter duration than eighteen (18) months or in cases where there is to be no Price Adjustment, the following provision shall not be included. Instead, it shall be indicated under this Appendix 2 that the prices are to remain firm and fixed for the duration of the Contract.
	67.3	If the value of the Index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next or in the final payment certificate. The Index value shall be deemed to take account of all changes in price due to fluctuations.
68. Liquidated Damages	68.1	Except as provided under GCC Sub Clause 56, if the Contractor fails to complete the Plant and Equipment Works within the Intended Completion Date or extended Intended Completion Date of the contract or Intended Sectional Completion Date or extended sectional completion date of any section under the contract, the Procuring Entity shall, as Liquidated Damages, deduct from the Contract Price, a sum at the percent-rate per day of delay as specified in the PCC, of the contract value of the uncompleted works or part thereof completed after the Intended Completion Date or extended Intended Completion Date, as applicable. The total amount of Liquidated Damages or Delay Damages shall not exceed the amount specified in the PCC. The Procuring Entity may deduct Liquidated Damages from payments due to the Contractor. Payment of Liquidated damages shall not affect the Contractor's liabilities.
G. Change in Contract Elements		
69. Change in the Facilities	69.1	<u>Introducing a Change</u> 69.1.1 Subject to GCC Sub-Clauses 69.2.5 and 69.2.7, the Procuring Entity shall have the right to propose, and subsequently require, that the Project Manager order the Contractor from time to time during the performance of the Contract to make any change, modification, addition or deletion to, in or from the Facilities hereinafter called "Change", provided that such Change falls within the general scope of the Facilities and does not constitute unrelated work and that it is technically practicable, taking into account both the state of advancement of the Facilities and the

		technical compatibility of the Change envisaged with the nature of the Facilities as specified in the Contract 69.1.2 The Contractor may from time to time during its performance of the Contract propose to the Procuring Entity with a copy to the Project Manager, any Change that the Contractor considers necessary or desirable to improve the quality, efficiency or safety of the Facilities. The Procuring Entity may at its discretion approve or reject any Change proposed by the Contractor, provided that the Procuring Entity shall approve any Change proposed by the Contractor to ensure the safety of the Facilities. 69.1.3 Notwithstanding GCC Sub-Clauses 64.1.1 and 64.1.2, no change made necessary because of any default of the Contractor in the performance of its obligations under the Contract shall be deemed to be a Change, and such change shall not result in any adjustment of the Contract Price or the Time for Completion. 69.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Sub-Clauses 64.2 and 64.3, and further details and forms are provided in the Procuring Entity's Requirements (Forms and Procedures)
	69.2	<u>Changes Originating from Procuring Entity</u> 69.2.1 If the Procuring Entity proposes a Change pursuant to GCC Sub-Clause 69.1.1, it shall send to the Contractor a "Request for Change Proposal," requiring the Contractor to prepare and furnish to the Project Manager as soon as reasonably practicable a "Change Proposal," which shall include the following: (a) brief description of the Change (b) effect on the Time for Completion (c) estimated cost of the Change (d) effect on Functional Guarantees (if any) (e) effect on the Facilities (f) effect on any other provisions of the Contract. 69.2.2 Prior to preparing and submitting the "Change Proposal," the Contractor shall submit to the Project Manager an "Estimate for Change Proposal," which shall be an estimate of the cost of preparing and submitting the Change Proposal. Upon receipt of the Contractor's Estimate for Change Proposal, the Procuring Entity shall do one of the following: (a) accept the Contractor's estimate with instructions to the Contractor to proceed with

		the preparation of the Change Proposal (b) advise the Contractor of any part of its Estimate for Change Proposal that is unacceptable and request the Contractor to review its estimate (c) advise the Contractor that the Procuring Entity does not intend to proceed with the Change. 69.2.3 Upon receipt of the Procuring Entity's instruction to proceed under GCC Sub-Clause 69.2.2 (a), the Contractor shall, with proper expedition, proceed with the preparation of the Change Proposal, in accordance with GCC Sub-Clause 69.2.1. 69.2.4 The pricing of any Change shall, as far as practicable, be calculated in accordance with the rates and prices included in the Contract. If such rates and prices are inequitable, the Parties thereto shall agree on specific rates for the valuation of the Change 69.2.5 If before or during the preparation of the Change Proposal it becomes apparent that the aggregate effect of compliance therewith and with all other Change Orders that have already become binding upon the Contractor under this GCC Clause 69 would be to increase or decrease the Contract Price as originally set forth in Article 2 (Contract Price) of the Contract Agreement by more than fifteen percent (15%), the Contractor may give a written notice of objection thereto prior to furnishing the Change Proposal as aforesaid. If the Procuring Entity accepts the Contractor's objection, the Procuring Entity shall withdraw the proposed Change and shall notify the Contractor in writing thereof. The Contractor's failure to so object shall neither affect its right to object to any subsequent requested Changes or Change Orders herein, nor affect its right to take into account, when making such subsequent objection, the percentage increase or decrease in the Contract Price that any Change not objected to by the Contractor represents. 69.2.6 Upon receipt of the Change Proposal, the Procuring Entity and the Contractor shall mutually agree upon all matters therein contained. Within fourteen (14) days after such agreement, the Procuring Entity shall, if it intends to proceed with the Change, issue the Contractor with a Change Order. If the Procuring Entity is unable to reach a decision within fourteen (14) days, it shall notify the Contractor with details of when the Contractor can expect a decision. If the Procuring Entity decides not to proceed with the Change for whatever reason, it shall, within the said period of fourteen (14) days, notify the Contractor accordingly. Under such circumstances, the Contractor

		shall be entitled to reimbursement of all costs reasonably incurred by it in the preparation of the Change Proposal, provided that these do not exceed the amount given by the Contractor in its Estimate for Change Proposal submitted in accordance with GCC Sub-Clause 69.2.2. 69.2.7 If the Procuring Entity and the Contractor cannot reach agreement on the price for the Change, an equitable adjustment to the Time for Completion, or any other matters identified in the Change Proposal, the Procuring Entity may nevertheless instruct the Contractor to proceed with the Change by issue of a "Pending Agreement Change Order." Upon receipt of a Pending Agreement Change Order, the Contractor shall immediately proceed with effecting the Changes covered by such Order. The Parties shall thereafter attempt to reach agreement on the outstanding issues under the Change Proposal.
	69.3	Changes Originating from Contractor 69.3.1 If the Contractor proposes a Change pursuant to GCC Sub-Clause 69.1.2, the Contractor shall submit to the Project Manager a written "Application for Change Proposal," giving reasons for the proposed Change and including the information specified in GCC Sub-Clause 69.2.1. Upon receipt of the Application for Change Proposal, the Parties shall follow the procedures outlined in GCC Sub-Clauses 69.2.6 and 69.3.2. However, should the Procuring Entity choose not to proceed, the Contractor shall not be entitled to recover the costs of preparing the Application for Change Proposal.
70. Extension of Delivery and Completion Schedule	70.1	The Contractor must deliver the Plant and the services procured within the period prescribed by the Procuring Entity, as specified in the TDS .
	70.2	The Time(s) for Completion specified in the PCC pursuant to GCC Sub-Clause 29.1 shall be extended if the Contractor is delayed or impeded in the performance of any of its obligations under the Contract by reason of any of the following: (a) any Change in the Facilities as provided in GCC Clause 69 (b) any occurrence of Force Majeure as provided in GCC Clause 56, unforeseen conditions as provided in GCC Clause 54, or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clause 50.2 (c) any suspension order given by the Procuring

		Entity under GCC Clause 44 hereof or reduction in the rate of progress pursuant to GCC Sub-Clause 71.2 or (d) any changes in laws and regulations as provided in GCC Clause 55 or (e) any default or breach of the Contract by the Procuring Entity, Appendix to the Contract Agreement titled, or any activity, act or omission of the Procuring Entity, or the Project Manager, or any other contractors employed by the Procuring Entity, or (f) any delay on the part of a sub-contractor, provided such delay is due to a cause for which the Contractor himself would have been entitled to an extension of time under this sub-clause, or (g) delays attributable to the Procuring Entity or caused by customs, or (h) any other matter specifically mentioned in the Contract by such period as shall be fair and reasonable in all the circumstances and as shall fairly reflect the delay or impediment sustained by the Contractor.
	70.3	Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Procuring Entity and the Contractor shall agree upon the period of such extension. The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.
	70.4	In all cases where the Contractor has given a notice of a claim for an extension of time under GCC 65.2, the Contractor shall consult with the Project Manager in order to determine the steps (if any) which can be taken to overcome or minimize the actual or anticipated delay. The Contractor shall there after comply with all reasonable instructions which the Project Manager shall give in order to minimize such delay. If compliance with such instructions shall cause the Contractor to incur extra costs and the Contractor is entitled to an extension of time under GCC 65.1, the amount of such extra costs shall be added to the Contract Price.
	70.5	Within twenty-one (21) days of receipt of the Contractor's notice, the Procuring Entity shall evaluate the situation and may grant time extensions, if based on justifiable grounds, without liquidated damages.

	70.6	The Procuring may extend up to thirty percent (30%) of the original contract time. above 30% of the original contract time as mentioned in GCC Sub Clause 70.1.
	70.7	In the case an extension of the original delivery schedule required under GCC Sub Clause 70.1 is or will be more than thirty (30) percent but not beyond one hundred (100) percent additional to the original Contract time, approval of the Head of the Procuring Entity or an officer authorized by him or her for the same shall be required.
	70.8	In exceptional cases, where an extension of the original contract time required under GCC Sub Clause 70.1 is or will be more than one hundred (100) percent of the original Contract time, approval of the Secretary of the concerned ministry or division for the same shall be required.
	70.9	Except in case of Force Majeure, as provided under GCC Clause 56, a delay by the Contractor in the performance of its delivery and completion obligations shall render the Contractor liable to the imposition of Liquidated Damages pursuant to GCC Clause 68, unless an extension of the Delivery and Completion Schedule is agreed upon, pursuant to GCC Clause 70.
71. Suspension	71.1	The Procuring Entity may request the Project Manager, by notice to the Contractor, to order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and the reasons thereof. The Contractor shall thereupon suspend performance of such obligation, except those obligations necessary for the care or preservation of the Facilities, until ordered in writing to resume such performance by the Project Manager. If, by virtue of a suspension order given by the Project Manager, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Procuring Entity shall, within twenty-eight (28) days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in accordance with GCC Clause 69, excluding the performance of the suspended obligations from the Contract. If the Procuring Entity fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects a part only of the Facilities, as a deletion of such part in accordance with GCC Clause 69 or, where it affects the whole of the Facilities
	71.2	If (a) the Procuring Entity has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any

		invoice or supporting documents without just cause pursuant to the Appendix to the Contract Agreement titled Terms and Procedures of Payment, or commits a substantial breach of the Contract, the Contractor may give a notice to the Procuring Entity that requires payment of such sum, with interest thereon as stipulated in GCC Sub-Clause 61.6, requires approval of such invoice or supporting documents, or specifies the breach and requires the Procuring Entity to remedy the same, as the case may be. If the Procuring Entity fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice or (b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Procuring Entity, including but not limited to the Procuring Entity's failure to provide possession of or access to the Site or other areas in accordance with GCC Sub-Clause 30.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities, then the Contractor may by fourteen (14) days' notice to the Procuring Entity suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.
	71.3	If the Contractor's performance of its obligations is suspended or the rate of progress is reduced pursuant to this GCC Clause 71, then the Time for Completion shall be extended in accordance with GCC Sub-Clause 43.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by the Procuring Entity to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract.
	71.4	During the period of suspension, the Contractor shall not remove from the Site any Plant, any part of the Facilities or any Contractor's Equipment, without the prior written consent of the Procuring Entity.
H. Termination and Settlement of Disputes		
72. Notice to Correct	72.1	If the Contractor fails to carry out any obligation under the Contract the Project Manager may, by giving a Notice to the Contractor, require the Contractor to make good the failure and to remedy it within a specified time ('Notice to Correct' in these

		Conditions). The Notice to Correct shall: (a) describe the Contractor's failure to comply with any contractual obligations; (b) state the Sub-Clause and/or provisions of the Contract under which the Contractor has the obligation; and specify the time within which the Contractor shall remedy the failure, which shall be reasonable, taking due regard of the nature of the failure and the work and/or other action required to remedy it.
	72.2	After receiving a Notice to correct the Contractor shall immediately respond but not later than 5 (five) days by giving a reply to the Project Manager describing the measures the Contractor will take to remedy the failure, and stating the date on which such measures will be commenced in order to comply with the time specified in the notice to correct. The time specified in the notice to correct shall not imply any extension of the Time for Completion.
73. Termination for Default	73.1	The Procuring Entity or the Contractor, without prejudice to any other remedy for breach of Contract, by giving fourteen (14) working-days written Notice of Termination mentioning the clause of breach to the other party, may terminate the Contract in whole or in part if the other party causes a fundamental breach of Contract. Fundamental breaches of the Contract shall include, but shall not be limited to, the following: i. the Contractor stops work for twenty-eight (28) days when no stoppage of work is shown on the current Programme or the Contractor stops works repeatedly without any valid ground and the stoppage has not been authorized by the Project Manager. ii. the Contractor fails to commence the work within the Start date; iii. the Contractor does not maintain a Security, which is required; iv. the Contractor fails to comply with instructions of the Notice to Correct as specified in GCC Clause 72; v. the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within eighty-four (84) days; vi. the Procuring Entity fails to handover the full works-site or a substantial portion of the works-site to the Contractor within eighty-four (84) days of contract signing. vii. the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager; viii. the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of Liquidated Damages can be paid, as specified in GCC Sub Clause 68;

		ix. the Contractor has subcontracted the Works exceeding the percentage as mentioned in GCC Sub Clause 23.1 or any subcontractor has been engaged during contract implementation without the prior approval of the Head of Procuring Entity or Authorized Officer as specified in GCC Sub Clause 23.6. x. the Contractor, in the judgment of the Procuring Entity has engaged in corrupt or fraudulent or collusive or coercive or obstructive practices, in case development partner, as defined in GCC Clause 6, in competing for or in executing the Contract. xi. A payment certified by the Project Manager is not paid by the Procuring Entity to the Contractor within eighty-four (84) days of the date of the Project Manager's certificate.
	73.2	If any of the events pointed out under GCC Sub Clause 72.1 or any such event that is not listed in that clause but can be deemed as a fundamental breach of a contract happens, the affected party shall notify (first notice- Notice of Default) the defaulted party of such event and its intention to terminate the contract making reference(s) to the relevant GCC Clauses and ask the defaulted party the reason why the affected party will not terminate the contract with a 21-day timeline from the issuance of the first notice to provide any clarification.
	73.3	If the Procuring Entity receives a reasonable clarification on the breaching event from the Contractor or the Contractor attempts and accomplishes any remedial action to mitigate the breach event, the Procuring Entity may affirm the contract without limiting its right to terminate the contract for any other fundamental breach by the Contractor.
	73.4	If the Procuring Entity does not receive any response or receive an unacceptable clarification on the breach event, it may terminate the contract mentioning an immediate effective date through a final notice.
	73.5	The final notice (Notice of Termination) will be issued by the Procuring Entity getting approval from the Head of the Procuring Entity and the Contractor shall not perform any activity after issuance of that notice.
	73.6	The Head of the Procuring Entity may create a Contract Termination Review Committee (CTRC) to assist him in the discharge of this function. All decisions recommended by the CTRC shall be subject to the approval of the Head of the Procuring Entity.
	73.7	In the event the Procuring Entity terminates the Contract in whole or in part, as stated under GCC Clause 73.1, the Procuring Entity may procure, upon such terms and in such manner as it deems appropriate, Plant similar to those not completed or not performed, and the Contractor shall be liable to the Procuring Entity for any additional costs as mentioned in the PCC for such similar Goods. However, the Contractor shall continue performance of the Contract to the extent not terminated.

74. Termination for Insolvency	74.1	The Procuring Entity shall terminate this Contract if the Contractor is declared bankrupt or insolvent as determined with finality by a court of competent jurisdiction. In this event, termination will be without compensation to the Contractor, provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the Procuring Entity and/or the Contractor.
75. Termination for Convenience	75.1	The Procuring Entity, by giving twenty-one (21) days written notice sent to the Contractor, may terminate this Contract, in whole or in part, at any time for its convenience. The notice of termination shall specify that the termination is for the procuring Entity's convenience, the extent to which performance of the Contractor under the contract is terminated, and the date upon which such termination becomes effective.
	75.2	The Goods that have been delivered and/or performed or are ready for delivery or performance within twenty-one (21) days after the Contractor's receipt of Notice to Terminate shall be accepted by the Procuring Entity at the contract terms and prices. For Goods not yet performed and/or ready for delivery, the Procuring Entity may elect: (a) to have any portion delivered and/or performed and paid at the contract terms and prices; and/or (b) to cancel the remainder and pay to the Contractor an agreed amount for partially completed and/or performed goods and for materials and parts previously procured by the Contractor
	75.3	The expiration of the Delivery and Completion Schedule, initiation of amicable settlement of disputes, adjudication and arbitral proceedings under the set terms and conditions shall not be deemed a termination of the contract.
76. Payment upon Termination	76.1	If the Contract is terminated because of a fundamental breach of Contract under GCC Sub Clause 73.1 by the Contractor, the Project Manager shall issue a certificate for the value of the Works done and Plant and Materials ordered less advance payments received up to the date of the issue of the certificate and less the amount from percentage to apply to the contract value of the works not completed, as indicated in the PCC. If the total amount due to the Procuring Entity exceeds any payment due to the Contractor, the difference shall be a debt payable to the Procuring Entity.
	76.2	If the Contract is terminated for the Procuring Entity's convenience or because of a fundamental breach of Contract by the Procuring Entity, the Project Manager shall issue a payment certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's foreign personnel employed solely on the Works and recruited specifically for the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

	76.3	If the Contract is terminated for reasons of Force Majeure, the The Project Manager shall determine the value of the work done and issue a Payment Certificate which shall include. (a) the amounts payable for any work carried out for which unit rates or prices are stated in the Contract; (b) the cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Procuring Entity when paid for by the Procuring Entity, and the Contractor shall place the same at the Procuring Entity's disposal; (c) other costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works; (d) the cost of removal of Temporary Works and Contractor's Equipment from the Site; and (e) the cost of repatriation of the Contractor's staff and labour employed wholly in connection with the Works at the date of termination.
77. Property	77.1	All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Procuring Entity if the Contract is terminated because of the Contractor's default stated under GCC Sub Clause 73.1.
78. Frustration	78.1	If the Contract is frustrated by the occurrence of a situation of Force Majeure as defined in GCC Sub Clause 56, the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all works carried out before receiving it and for any work carried out afterwards to which a commitment was made.
79. Amendment to Contract	79.1	The amendment to Contract shall generally include equitable adjustments in original Contract price, Delivery and Completion Schedule and, any other changes acceptable under the conditions of the Contract.
	79.2	The Procuring Entity shall amend the Contract, incorporating the changes approved in accordance with the Delegation of Financial Power or sub-delegation thereof and, introduced to the original terms and conditions of the Contract.
80. Compensation Events	80.1	The following shall be Compensation Events: (a) The Procuring Entity does not give access to or possession of the Site or part of the Site by the Site Possession Date stated in the GCC Sub Clause 18.1; (b) The Procuring Entity modifies the Schedule of other Contractors in a way that affects the works of the Contractor under the Contract; (c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions

		required for execution of the Works on time; (d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects; (e) The Project Manager unreasonably does not approve a subcontract to be let, if applicable; (f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Notification of Award from the information issued to Tenderers (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site; Other Contractors, public authorities, utilities, or the Procuring Entity do not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor; (g) The advance payment is delayed; (h) The effects on the Contractor of any of the Procuring Entity's Risks; (i) The Project Manager unreasonably delays issuing a Completion Certificate; (j) A situation of Force Majeure has occurred, as defined in GCC Clause 56; and (k) Other Compensation Events described in the Contract or determined by the Project Manager in the PCC shall apply.
	80.2	If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended, only on justifiably acceptable grounds duly recorded.
	80.3	As soon as the Contractor has provided information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost, the Project Manager shall assess it, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager will assume that the Contractor will react competently and promptly to the event.
	80.4	The Contractor shall not be entitled to compensation to the extent that the Procuring Entity's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Project Manager.
81. Contractor's Claims	81.1	If the Contractor considers himself to be entitled to any extension of the Completion Time and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Procuring Entity, describing the event or circumstance giving rise to the claim. The notice shall be

		given as soon as practicable, and not later than twenty-eight (28) days after the Contractor became aware, or should have become aware, of the event or circumstance
	81.2	If the Contractor fails to give notice of a claim within such period of twenty-eight (28) days, the Intended Completion Date shall not be extended, the Contractor shall not be entitled to additional payment, and the Procuring Entity shall be discharged from all liability in connection with the claim.
	81.3	Within forty-two (42) days after the Contractor became aware or should have become aware of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed, for settlement.
82. Settlement of Disputes	82.1	<u>Amicable Settlement:</u> The Procuring Entity and the Contractor shall use their best efforts to settle amicably all disputes arising out of or in connection with this Contract or its interpretation.
	82.2	<u>Adjudication</u> (a) If the Contractor /Procuring Entity believe that amicable settlement of dispute is not possible between the two parties, the dispute shall be referred to the Adjudicator within fourteen (14) days of first written correspondence on the matter of disagreement; (b) The Adjudicator named in the PCC is jointly appointed by the parties. In case of disagreement between the parties, the Appointing Authority designated in the PCC shall appoint the Adjudicator within fourteen (14) days of receipt of a request from either party; (c) The Adjudicator shall give its decision in writing to both parties within twenty-eight (28) days of a dispute being referred to it; (d) The Contractor shall make all payments (fees and reimbursable expenses) to the Adjudicator, and the Procuring Entity shall reimburse half of these fees through the regular progress payments; (e) Should the Adjudicator resign or die, or should the Procuring Entity and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract; a new Adjudicator will be jointly appointed by the Procuring Entity and the Contractor. In case of disagreement between the Procuring Entity and the Contractor the Adjudicator shall be designated by the Appointing Authority designated in the PCC at the

		request of either party, within fourteen (14) days of receipt of a request from either Party
	82.3	<u>Arbitration</u> (a) If the Parties are unable to reach a settlement under GCC Clause 82.1 or 82.2 within twenty-eight (28) days of the first written correspondence on the matter of disagreement or within twenty-eight (28) days of the date of decision made by the Adjudicator as per GCC Sub Clause 82.2(c), then either Party may give notice to the other party of its intention to commence arbitration in accordance with GCC Sub Clause 82.3(b); (b) The arbitration shall be conducted in accordance with the Arbitration Act (Act No 1 of 2001) of Bangladesh as at present in force and in the place shown in the PCC

Section 4. Particular Conditions of Contract

GCC Clause	Amendments of, and Supplements to, Clauses in the General Conditions of Contract
GCC 1.1(ll)	The Procuring Entity is Office of the Superintending Engineer (Grid & Sub-Station), Bangladesh Rural Electrification Board, Dhaka.
GCC 1.1(mm)	The Project Manager is: Executive Engineer, System Operation and Distribution, Dhaka (North), BREB. The project management shall be done under Superintending Engineer, Dhaka (North) Zone, BREB, Dhaka. Executive Engineer, System Operation and Distribution, Dhaka (North), BREB shall act as Project Manager and shall be responsible for supervising the execution and completion of the works and physical services and administering the Contract under Superintending Engineer, Dhaka (North) Zone, BREB, Dhaka.
GCC 1.1(tt)	The site(s) is/are is located at: Palashbari Substation, Dhaka, of Dhaka PBS-1
GCC 3.1	For <u>notices</u> , the Procuring Entity's contact details shall be: (i) Office of the Superintending Engineer (Grid & Sub-Station) Bangladesh Rural Electrification Board, 3rd Floor, Executive Building, Nikunja-2, Khilkhet, City: Dhaka-1229, Country: Bangladesh. Tel: + <u>8802</u> - 8900757 E-mail: segridssbreb@gmail.com (ii) Superintending Engineer, Dhaka (North) Zone, BREB, Dhaka. (iii) Executive Engineer (SOD), Dhaka (North), BREB. For <u>notices</u> , the Contractor's contact details shall be: Attention: Address: Telephone: Facsimile number: Electronic mail address:
GCC 7.1(k)	The following documents shall also be part of the Contract: None
GCC 9.1	The Contractor or the Subcontractor that is a national of, or registered in, the following countries are not eligible: Israel
GCC 9.2	Materials, Equipment and associated services from the following counties are not eligible: Israel
GCC 16.1	Nominated Subcontractor(s) named below: None
GCC 18.1	Possession of the Site or part(s) of the Site, to the Contractor shall be given on the following date(s); Within 7 (Seven) days from the date of contract signing.
GCC 27.3	The Contractor agrees to supply spare parts for a period of five years .
GCC 28.1	The Contractor shall commence work on the Facilities within 7 (Seven) days from the Effective Date for determining Time for Completion as specified in the Contract Agreement.
GCC 29.1	The time for completion of the whole of the facilities within 365 Days from the effective date as described in the contract agreement.
GCC 41.2	i) The pre-shipment inspection and testing of the materials (33kV OVCB, CRP, Power transformer, Auxiliary transformer, CT, PT, 11kV Switchgear, Substation Automation System and Steel structure) shall be carried out in presence of Minimum Two (02) representatives of BREB/PBS for at least 5 (Five) days or Third Party of BREB's Choice (if BREB/PBS is unable to go) at the manufacturer's factory. The expense of inspection is deemed to be

	included in the applicable item of the price schedule. Shipment clearance will be given after satisfactory completion of pre-shipment inspection of the materials. ii) The Supplier shall notify the purchaser at least Four (4) weeks in advance of the date or dates when the products and /or components will be ready for inspection. Such date must be fixed at least 15 (fifteen) days prior to the due delivery date. iii) In case the purchaser or its representative does not get the product ready for inspection on the specified date as per inspection notice of the tenderer, the fee for any further visit / visits will be borne by the contractor, in addition to liquidated damage applicable as per terms & conditions of the schedule. iv) Any factory inspection prior to delivery or final inspection at the destination of delivery shall not relieve the supplier from full responsibility for furnishing material and / or equipment conforming to the technical specifications contained herein, nor prejudice any claim, right or privilege which the purchaser may have under the warranty furnished by the manufacturer/contractor in accordance with the Tender Document. v) Post Landing Inspection (PLI) shall be done after the arrival of goods at site. The PLI shall be conducted by BREB engineers in presence of contractor. The purchaser has right to inspect, test where necessary and reject the goods arrived in the project site shall in no way be limited or waived by reason of the goods having previously been tested and passed by manufacturer/supplier, The purchaser can test the goods in any third party laboratory if necessary. Contractor shall bear all the cost regarding all the test, transportation, loading/unloading. The contractor shall bear all costs regarding all testing.
GCC 43.2.2	The Guarantee Test of the Facilities shall be successfully completed within 15 Days from the date of Completion.
GCC 44.3	No bonus will be given for earlier Completion of the Facilities or part thereof.
GCC 45.3	The amount to be withheld for late submission of an updated Programme is USD/GBP/EU R/JPY/BDT <i>[insert amount]</i> <i>Bangladesh Taka</i> ~~delete~~ ~~not appropriate~~ ~~delete if not appropriate~~ <i>[insert amount]</i>
GCC 45.10	The critical components covered under the extended defect liability are: None
48.1 (b)	The multiplier of the Contract Price is: Not Applicable.
GCC 52.1	The insurance cover shall be: (a) The minimum cover for the Works and of Plant and Materials is 110%. (b) The maximum deductible for insurance of the Works and of Plant and Materials is 3% of the sum insured. (c) The minimum cover for loss or damage to Equipment is 110%. (d) The maximum deductible for insurance of Equipment is 3% of the sum insured. (e) The minimum cover for other property is 10%. (f) The maximum deductible for insurance of other property is 3% of the sum insured. (g) The minimum cover for personal injury or death: (i) for the Contractor's employees is as per the law and common practice in Bangladesh. (ii) and for third parties is as per the law and common practice in Bangladesh.
GCC 60.2	The Contract Price shall not be adjusted.
GCC 60.4	The Contract is not subject to price adjustment.

GCC 61.1	The original Contract price is: <i>[insert the amount in the NOA]</i>
GCC 61.1	The Advance Payment shall be Tk <i>[insert amount]</i> and shall be paid to the Contractor not later than <i>[insert date]</i> . Not Applicable.
GCC 61.5	The rate of interest shall be the prevailing rate of interest for commercial borrowing established in the country. None
GCC 63.1	The amount of performance security, as a percentage of the Contract Price for the Facility or for the part of the Facility for which a separate Time for Completion is provided, shall be 10% of the Contract Price.
GCC 63.4	The performance security shall not be reduced before the date of the Operational Acceptance.
GCC 63.4	The performance security shall be reduced to ten percent (10%) of the value of the component covered by the extended defect liability to cover the Contractor's extended defect liability in accordance with the provision in the PCC, pursuant to GCC Sub-Clause 42.10.
GCC 64.1	The portion of payments to be retained is five (5) percent of the contract price. In case of front loading or unbalanced price loading, PE may extend this proportion up to twenty (20) percent of the contract price. In such cases, money retained for meeting any claims during Defect Liability Period shall be half of the total money retained but not less than five (5) percent of the contract price.
GCC 68	The amount of Liquidated Damages is 0.075 of ONE (1) percent of the contract value of the uncompleted works or any part thereof completed after expiry of the Intended Completion Date or extended Intended Completion Date, as applicable, per day of delay. The maximum amount of Liquidated Damages for the uncompleted Works or any part thereof is 10% (ten) percent of the final Contract Price of the whole of the Works.
GCC 82.2(b)&(e)	The Adjudicator jointly appointed by the Parties is: The Adjudicator will be appointed as per situation arise in future. The Hourly fee will be 10000 Tk. BREB will appoint the Adjudicator.
	In case of disagreement between the parties, the Appointing Authority for the Adjudicator is the President of the Institution of Engineers, Bangladesh (IEB).
GCC 82.3	In the case of a dispute between the Procuring Entity and the foreign Contractor , <i>[insert any of the following options]</i> Any dispute, controversy or claim arising out of or relating to this Contract, or breach, termination or invalidity thereof, shall be settled by arbitration in accordance with the United Nations Commission on International Trade Law (UNCITRAL) Arbitration Rules of 1976 as at present in force. OR All disputes arising in connection with the present Contract shall be finally settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators in accordance with the said rules. Not Applicable.

Appendix to the Tender

[In Tables below, the Procuring Entity shall indicate the source and base values with dates of Indexes, unless otherwise instructed to be quoted by the Tenderer, for the different Cost Components and mention its Weightings or Coefficients]

Table 1.1: Price Adjustment Data

[ITT Sub Clause 26: To be provided by the Procuring Entity]

Index Descriptions	Base Value	Sources of Index

Note:

1. The sources of Indexes and its values with dates shall be Bangladesh Bureau of Statistics (BBS) unless otherwise mentioned by the Procuring Entity or instructed to be quoted by the Tenderer.
2. The Procuring Entity may require the Tenderer to justify its proposed Indexes, if quoted by the Tenderer.
3. The Base Value of the Indexes shall be those prevailing twenty-eight (28) days prior to the deadline for submission of the Tenders.

Table 1.2: Price Adjustment Data

[GCC Sub Clause 67: To be provided by the Procuring Entity]

Item Group	Bill No. if applicable	Index Descriptions	Coefficients or Weightings for non-adjustable Cost Component	Coefficients or Weightings for adjustable Cost Components										Total
				a	b	c	d	e	f	g	h	i	j	
														1
														1
														1
														1
														1
														1

Note:

The Weightings or Coefficients of the Cost Components shall be mentioned by the Procuring Entity based on the proportion of components involved in the items caused to be impacted by rise and fall in its prices.

APPENDICES [These appendixes shall be the part of the contract]

- Appendix 1 - Terms and Procedures of Payment
- Appendix 2 - Price Adjustment
- Appendix 3 - Insurance Requirements
- Appendix 4 - Time Schedule
- Appendix 5 - List of Major Items of Plant and services and List of Approved Subcontractors
- Appendix 6 - Scope of Works and Supply by the Procuring Entity
- Appendix 7 - List of Documents for Approval or Review
- Appendix 8 - Functional Guarantees

Appendix 1. Terms and Procedures of Payment

(A) Terms of Payment

Schedule No. 1 - Plant and Mandatory Spare Parts

In respect of plant and equipment supplied from within the Procuring Entity's country, the following payments shall be made:

Eighty percent (75%) of the total or pro rata EXW amount upon Incoterm "Ex-Works," upon delivery to the carrier within forty-five (45) days after receipt of invoice.

Five percent (15%) of the total or pro rata CIP/EXW amount upon Incoterm "Ex-Works", upon place/install in accordance with the design layout (i.e., Relevant civil works & others must be completed as required for placing the equipments as per design layout) within 45 days after receipt of invoice.

Five percent (5%) of the total or pro rata EXW amount after commissioning, within forty-five (45) days after receipt of invoice.

Five percent (5%) of the total or pro rata EXW amount upon issue of the Operational Acceptance Certificate, within forty-five (45) days after receipt of invoice.

Schedule No. 2 - Installation and other Services

In respect of installation services for both the foreign and local currency portions, the following payments shall be made:

Eighty percent (80%) of the measured value of work performed by the Contractor, as identified in the said Program of Performance, during the preceding month, as evidenced by the Procuring Entity's authorization of the Contractor's application, will be made monthly within forty-five (45) days after receipt of invoice.

Five percent (15%) of the total or pro rata value of installation services performed by the Contractor as evidenced by the Procuring Entity's authorization of the Contractor's monthly applications, upon commissioning, within forty-five (45) days after receipt of invoice.

Five percent (5%) of the total or pro rata value of installation services performed by the Contractor as evidenced by the Procuring Entity's authorization of the Contractor's monthly applications, upon issue of the Operational Acceptance Certificate, within forty-five (45) days after receipt of invoice.

(B) Payment Procedures

The procedures to be followed in applying for certification and making payments shall be as follows:

1. All costs in connection with invoice and document within Bangladesh/Procuring Entity's country shall borne by the Procuring Entity and outside of the Bangladesh/Procuring Entity's country shall be borne by the Contractor but tenderer shall be paid as per quoted price by the Procuring Entity.
2. Amount of contract Price will be paid by the Procuring Entity's designated Bank.
3. The retention money shall be deducted @ ten (10) percent from the successful Tenderer's payable invoices during contract implementation.

Appendix 2. Price Adjustment (Not Applicable)

Prices payable to the Contractor, in accordance with the Contract, shall be subject to adjustment during performance of the Contract to reflect changes in the cost of labor and material components, in accordance with the following formula:

The Contract is subject to price adjustment applying the following formulae and the weightings or coefficients:

[Price Adjustment Formulae to be applicable if stated under ITT Sub Clause 26.9 shall be specified here]

Example:

$$P = A + a (Lm/Lo) + b (BIm/BIo) + c (CEm/CEo) + d (RSm/RSo) + e (STm/STo) + f (BRm/BRo) + g (MI m/MIo) + h (FU m/FUo) + etc$$

where;

L= Labor, BI=Bitumen, CE=Cement, RS=Reinforcing Steel, ST=Stone, BR=Bricks, MI=Miscellaneous, FU= Fuel]

Weighting or Coefficient A equals between 0.10 and 0.15 and, B (a+b+c+d+e+f+g+h+etc) equals between 0.90 and 0.85.

[insert figure] non-adjustable component (coefficient A)

[insert figure] adjustable component (coefficient B)

[The sum of A+B shall equal ONE (1). It is usual to have value of A between 0.10 and 0.15 and that of B between 0.90 and 0.85. Breakdown of B shall be provided in Appendix to the Tender.]

[delete as appropriate]

The date of adjustment shall be the mid-point of the period of manufacture or installation of component or Plant.

The following conditions shall apply:

- (a) No price increase will be allowed beyond the original delivery date unless covered by an extension of time awarded by the Procuring Entity under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Procuring Entity will, however, be entitled to any price decrease occurring during such periods of delay.
- (c) No price adjustment shall be payable on the portion of the Contract price paid to the Contractor as an advance payment.

For complex plant supply and installation involving several sources of supply and/or a substantial amount of installation works, a family of formulas may be necessary, with provision for the usage of Contractor's equipment in the works formula.

Appendix 3. Insurance Requirements

Insurances To Be Taken Out by The Contractor

In accordance with the provisions of GCC Clause 52, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Procuring Entity, such approval not to be unreasonably withheld.

All insurances are to be taken from **Sadharan Bima Corporation**.

(a) Cargo Insurance

Covering loss or damage occurring, while in transit from the supplier's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the construction equipment to be provided by the Contractor or its Subcontractors.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
110% of the contract price	-	Bangladesh Rural Electrification Board	Supplier's or manufacturer's works or stores	Site

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the defect liability period while the Contractor is on the Site for the purpose of performing its obligations during the defect liability period.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
110% of the contract price	-	Bangladesh Rural Electrification Board	Supplier's or manufacturer's works or stores	Site

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties (including the Procuring Entity's personnel) and loss of or damage to property (including the Procuring Entity's property and any parts of the Facilities that have been accepted by the Procuring Entity) occurring in connection with the supply and installation of the Facilities.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
For the contractor employees is as per law and common practice in Bangladesh				

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities. Comprehensive insurance in accordance with statutory requirements.

(e) Workers' Compensation

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(f) Procuring Entity's Liability

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(g) Other Insurances

The Contractor is also required to take out and maintain at its own cost the following insurances:

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
Nil	Nil	Nil	Nil	Nil

The Procuring Entity shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 52.1, except for the Third-Party Liability, Workers' Compensation and Procuring Entity's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 52.1, except for the Cargo, Workers' Compensation and Procuring Entity's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

Insurances to be Taken Out by The Procuring Entity

If the Procuring Entity is proposing to take out any or all of the above insurances itself, or any other insurances in respect of the Facilities, either in its own name or in the joint names of itself and the Contractor, it shall give details below prior to issuing the tender documents. Under the terms of the Contract, the Contractor and the Contractor's Subcontractors shall be named as co-insured under all such policies.

The Procuring Entity shall at its expense take out and maintain in effect during the performance of the Contract the following insurances.

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
Nil	Nil	Nil	Nil	Nil

Appendix 4. Time Schedule

The time for completion of whole facilities shall be as specified in the PCC against sub-clause GCC-29.1.

Appendix 5. List of Major Items of Plant and Services and List of Approved Subcontractors

Appendix 6. Scope of Works and Supply by the Procuring Entity

The following personnel, facilities, works and supplies shall apply as appropriate.

All personnel, facilities, works and supplies will be provided by the Procuring Entity in good time so as not to delay the performance of the Contractor, in accordance with the approved Time Schedule and Program of Performance pursuant to GCC Sub-Clause 37.2.

Unless otherwise indicated, all personnel, facilities, works and supplies will be provided free of charge to the Contractor.

Personnel	Charge to Contractor (if any)
Procuring Entity's personnel will be engaged to supervise and certify the works and tests. Name of the personnel will be informed later on.	No Charge to the contractor

Facilities	Charge to Contractor (if any)
Power shutdown as required and approved by the Procuring Entity for the execution of works	No charge to contractor/not payable
Information/Data on incoming source of electric power	No charge to contractor/not payable
Assistance in availing of other utility services.	Charge to contractor if applicable.
The Procuring Entity will not provide any storage facility to the contractor. Contractor shall be responsible to provide storage facility In the event of any such requirement and subject to availability, the Procuring Entity may extend the facility to use such storage facility by the contractor on rental charge/cost basis normal terms and conditions.	The amount determined by the Procuring Entity to be paid by the contractor.

Works	Charge to Contractor (if any)
Procuring Entity will not do any works. Contractor shall responsible to execution the contract. If contractor do not reinstate the Procuring Entity's existing facilities (Civil fencing and other ancillaries) Procuring Entity will complete it.	Will be deducted from contractor's payment.

Supplies	Charge to Contractor (if any)
The Procuring Entity will not generally supply any machinery/equipment and materials to the contractor. The contractor shall be responsible to supply any machinery and materials for the contract. In the event of any such requirement and subject to availability, the Procuring Entity may extend the facilities to use such machinery and materials by the contractor on rental charge/cost under normal terms and conditions	The amount determined by the Procuring Entity to be paid by the contractor.

Appendix 7. List of Documents for Approval or Review

Pursuant to GCC Sub-Clause 38.3.1, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of GCC Sub-Clause 37.2 (Program of Performance), the following documents for

(A) Approval

- (1) Project implementation schedule, Project organogram, Detail drawing schedule.
- (2) Technical particular & Guarantees and Drawing, catalogue and operational manuals, from manufacturer for each type of Equipment, Insulator, Conductor, Earth wire and Hard ware fittings.
- (3) Protection and metering scheme.
- (4) Steel structures.
- (5) Overhead earth screen.
- (6) Plan drawing and Design of all Civil structures.
- (7) All civil and foundation works
- (8) Routine and factory acceptance test plan of each Equipment, Conductor, Insulator, Earth wire, Hardware fittings and Steel structures.
- (9) Pre-commissioning and commissioning Test Plan.
- (10) Any other relevant design-drawing & documents as per the Contract Documents to the complete respective works.

(B) Review

Any documents listed above are to be reviewed if required to complete the works.

Appendix 8. Functional Guarantees

1. General

This Appendix sets out

- (a) the functional guarantees referred to in GCC Clause 46 (Functional Guarantees)
- (b) the preconditions to the validity of the functional guarantees, either in production and/or consumption, set forth below
- (c) the minimum level of the functional guarantees
- (d) the formula for calculation of liquidated damages for failure to attain the functional guarantees.

2. Preconditions

The Contractor gives the functional guarantees (specified herein) for the facilities, subject to the following preconditions being fully satisfied: *[List any conditions for the carrying out of the Guarantee Test referred to in GCC Sub-Clause 43.2]*

3. Functional Guarantees

Subject to compliance with the foregoing preconditions, the Contractor guarantees as follows:

- 3.1 Production Capacity** Satisfactory completes all commissioning tests, Procuring Entity's requirements. All equipment shall be proven to function as required in the individual specifications provided.
- 3.2 Raw Materials and Utilities Consumption** Satisfactory completes all commissioning tests, Procuring Entity's requirements. All equipment shall be proven to function as required in the individual specifications provided.

4. Failure in Guarantees and Liquidated Damages

4.1 Failure to Attain Guaranteed Production Capacity

If the production capacity of the facilities attained in the guarantee test, pursuant to GCC Sub-Clause 43.2, is less than the guaranteed figure specified in para. 3.1 above, but the actual production capacity attained in the guarantee test is not less than the minimum level specified in para. 4.3 below, and the Contractor elects to pay liquidated damages to the Procuring Entity in lieu of making changes, modifications and/or additions to the Facilities, pursuant to GCC Sub-Clause 46.3, then the Contractor shall pay liquidated damages at the rate of *[amount in the contract currency]* for every complete one percent (1%) of the deficiency in the production capacity of the Facilities, or at a proportionately reduced rate for any deficiency, or part thereof, of less than a complete one percent (1%).

4.2 Raw Materials and Utilities Consumption in Excess of Guaranteed Level

[To be specified in the appropriate wording for the type of facilities if there are consumption guarantee]

If the actual measured figure of specified raw materials and utilities consumed per unit (or their average total cost of consumption) exceeds the guaranteed figure specified in para. 3.2 above (or their specified average total cost of consumption), but the actual consumption attained in the guarantee test, pursuant to GCC Sub-Clause 43.2, is not more than the maximum level specified in para. 4.3 below, and the Contractor elects to pay liquidated damages to the Procuring Entity in lieu of making changes, modifications and/or additions to the Facilities pursuant to GCC Sub-Clause 46.3, then the Contractor shall pay liquidated damages at the rate of *[amount in the contract currency]* for every complete one percent (1%) of the excess consumption of the Facilities, or part thereof, of less than a complete one percent (1%).

[The rate of liquidated damages specified in paras. 4.1 and 4.2 above shall be at least equivalent to the rate specified in Section 3 (General Conditions of Contract) for the comparison of functional guarantees provided by the Tenderers]

4.3 Minimum Levels

Notwithstanding the provisions of this paragraph, if as a result of the guarantee test(s), the following minimum levels of performance guarantees (and consumption guarantees) are not attained by the Contractor, the Contractor shall at its own cost make good any deficiencies until the Facilities reach any of such minimum performance levels, pursuant to GCC Sub-Clause 46.2:

- (a) production capacity of the Facilities attained in the guarantee test: ninety-five percent (95%) of the guaranteed production capacity

and/or

- (b) average total cost of consumption of all the raw materials and utilities of the Facilities: one hundred and five percent (105%) of the guaranteed figures.

4.4 Limitation of Liability

Subject to para. 4.3 above, the Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantees shall not exceed *[the percentage specified shall not exceed ten percent (10%)]*. percent (... %) of the Contract price

Section 5. Tender and Contract Forms

Form	Title
Tender Forms	
PG5A-1a	Tender Submission Letter for Technical Offer
PG5A-1b	Tender Submission Letter for Financial Offer
PG5A-1c	Letter of Authorization
PG5A-2a	Tenderer Information
PG5A-2b	JV Partner Information (<i>if applicable</i>)
PG5A-2c	Subcontractor Information (<i>if applicable</i>)
PG5A-3	Price Schedule for Plant and Services
PG5A-4	Technical Proposal
PG5A-5	Specifications Submission and Compliance Sheet
PG5A-6	Manufacturer's Authorisation Letter
PG5A-7	Bank Guarantee for Tender Security (<i>when this option is chosen</i>)
PG5A-8	Bank's Letter of Commitment for Line of Credit (<i>when this option is chosen</i>)
Contract Forms	
PG5A-9	Notification of Award
PG5A-10	Contract Agreement
PG5A-11	Bank Guarantee for Performance Security (<i>when this option is chosen</i>)
PG5A-12	Bank Guarantee for Advance Payment (<i>if applicable</i>)
PG5A-13	Bank Guarantee for Retention Money Security (<i>when this option is chosen</i>)
PG5A-14	Contract Amendment

Forms PG5A-1 to PG5A-8 are the contents of the Tender Forms and should be completed as stated in ITT Clauses 23.

Forms PG5A-9 to PG5A-14 are the contents of the Contract Forms as stated in GCC Clause 7.

Tender Submission Letter for Technical Offer (Form PG5A-1a)

[This format shall be completed and signed by the Tenderer or his/her Authorised Signatory, without alterations, on the Letter-head pad of the Tenderer]

To: <i>[Contact Person]</i> <i>[Name of the Procuring Entity]</i> <i>[Address of the Procuring Entity]</i>	Date:
Invitation for Tender No:	<i>IFT No.</i> _____
Tender Package No:	<i>Package No.</i> _____
Lot No: (<i>when applicable</i>)	<i>Lot No.</i> _____

We, the undersigned, offer to design, manufacture, test, deliver, install, pre-commission and commission in conformity with the Tender Document, the following Plant and Services, viz:

In signing this letter, and in submitting our Tender, we also confirm that:

- (a) our Tender shall be valid for the period stated in the Tender Data Sheet (ITT Sub Clause 32.1) and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (b) a Tender Security is attached in the form of a *[state Pay Order, Bank Draft, Bank Guarantee]* in the amount stated in the Tender Data Sheet (ITT Sub Clause 34.1) and valid for a period of twenty-eight (28) days beyond the Tender Validity date;
- (c) we have examined and have no reservations to the Tender Document, issued by you on *[insert date]*; including Addendum to Tender Document No(s) *[state numbers]*, issued in accordance with the Instructions to Tenderers (ITT Clause 11). *[insert the number and issuing date of each addendum; or delete this sentence if no Addendum has been issued]*;
- (d) we, including as applicable, any JV partner or Subcontractor for any part of the contract resulting from this Tender process, have nationalities from eligible countries, in accordance with ITT Sub Clause 5.1;
- (e) we are submitting this Tender as a sole Tenderer in accordance with ITT Sub Clause 19.1

or

we are submitting this Tender as the partners of a JV, comprising the following other partners in accordance with ITT Clause 17;

	Name of Partner	Location & District of Partner
1		
2		
3		

4		

- (f) *we are not a Government owned entity as defined in ITT Sub Clause 5.10*
or
we are a Government owned entity, and we meet the requirements of ITT Sub Clause 5.10;
- (g) we, including as applicable any JV partner, declare that we are not associated, nor have been associated in the past, directly or indirectly, with a consultant or any other entity that has prepared the design, specifications and other documents in accordance with ITT Sub Clause 5.6;
- (h) we, including as applicable any JV partner or Subcontractor for any part of the contract resulting from this Tender process, have not been declared ineligible by the Government of Bangladesh on charges of engaging in corrupt, fraudulent, collusive, coercive or obstructive practices in accordance with ITT Sub Clause 5.7;
- (i) furthermore, we are aware of ITT Clause 4 concerning such practices and pledge not to indulge in such practices in competing for or in executing the Contract;
- (j) we intend to subcontract an activity or part of the Works, in accordance with ITT Clause 18.1 to the following Subcontractor(s);

Activity or part of the Plant and services	Name of Subcontractor with Location and District

- (k) we, including as applicable any JV partner, confirm that we are not currently suspended or debarred in connection with ITT Clause 5.8,
- (l) we are not participating as Tenderer in more than one Tender in this Tendering process. We understand that your written Notification of Award shall constitute the acceptance of our Tender and shall become a binding Contract between us, until a formal Contract is prepared and executed;
- (m) we, including as applicable any JV partner, confirm that we do not have a record of insolvency, receivership, bankrupt or being wound up, our business activities were not been suspended, and it was not been the subject of legal proceedings in accordance with ITT Sub Clause 5.9;
- (n) we, including as applicable any JV partner, confirm that we have fulfilled our obligations to pay taxes and social security contributions applicable under the relevant national laws and regulations of Bangladesh in accordance with ITT Sub Clause 5.5;
- (o) we understand that you reserve the right to reject all the Tenders or annul the Tender proceedings, without incurring any liability to Tenderer, in accordance with ITT Clause 60.

Signature:	<i>[insert signature of authorised representative of the Tenderer]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
In the capacity of:	<i>[insert capacity of signatory]</i>

Duly authorised to sign the Tender for and on behalf of the Tenderer

[If there is more than one (1) signatory, or in the case of a JV, add other boxes and sign accordingly].

Attachment 1:

[ITT Sub Clause 39.4]

Written confirmation authorising the above signatory(ies) to commit the Tenderer

[and, if applicable]

Attachment 2:

[ITT Sub Clause 28.2(b)]

Copy of the JV Agreement / Letter of Intent to form JV with draft proposed Agreement

Tender Submission Letter for Financial Offer (Form PG5A-1b)

[This format shall be completed and signed by the Tenderer or his/her Authorised Signatory, without alterations, on the Letter-head pad of the Tenderer]

To: <i>[Contact Person]</i> <i>[Name of the Procuring Entity]</i> <i>[Address of the Procuring Entity]</i>	Date:
Invitation for Tender No:	<i>IFT No.</i> _____
Tender Package No:	<i>Package No.</i> _____
Lot No: <i>(when applicable)</i>	<i>Lot No.</i> _____

We, the undersigned, offer to design, manufacture, test, deliver, install, pre-commission and commission in conformity with the Tender Document, the following Plant and Services, viz:

In accordance with ITT Clause 26 and 27, the following price applies to our Tender:

The Tender price is: (ITT Sub Clause 26.4 and 27)	Amount _____ <i>[in figures]</i> Amount _____ <i>[in words]</i>
Plant (including Mandatory Spare Parts) Supplied from abroad	Amount _____ <i>[in figures]</i> Amount _____ <i>[in words]</i>
Plant (including Mandatory Spare Parts) supplied from within the Procuring Entity's Country	Tk. _____ <i>[in figures]</i> Taka _____ <i>[in words]</i>
Design Services	Amount _____ <i>[in figures]</i> Amount _____ <i>[in words]</i>
Installation and Other Services	Amount _____ <i>[in figures]</i> Amount _____ <i>[in words]</i>
Recommended Spare parts Price (If economic Factor is applicable)	Amount _____ <i>[in figures]</i> Amount _____ <i>[in words]</i>

The advance payment (when applicable) is: <i>[insert the amount based on percentage of the Tender Price]</i> (GCC Sub Clause 61.1)	Taka _____ <i>[in words]</i> Taka _____ <i>[in words]</i>
and we shall accordingly submit an Advance Payment Guarantee in the format shown in Form PW3A-11 .	
In accordance with ITT Clause 28, the following discounts shall apply to our Tender:	
The unconditional discount proposed in this package/Lot/other lot(s) of the Tender is:	In Percentage (%).-----
The discount shall be equally applicable on all the items of Schedule of requirements within each lot after arithmetical correction.	

In signing this letter, and in submitting our Tender, we also confirm that:

- (a) our Tender shall be valid for the period stated in the Tender Data Sheet (ITT Sub Clause 32.1) and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (b) a Tender Security is attached in the form of a *[state Pay Order, Bank Draft, Bank Guarantee]* in the amount stated in the Tender Data Sheet (ITT Sub Clause 34.1) and valid for a period of twenty-eight (28) days beyond the Tender Validity date;
- (c) if our Tender is accepted, we commit to furnishing a Performance Security within the time stated under ITT Sub Clause 67.2 in the amount stated in the Tender Data Sheet (ITT Sub Clause 66.1) and in the form specified in the Tender Data Sheet (ITT Sub Clause 66.1) valid for a period of twenty-eight (28) days beyond the date of issue of the Completion Certificate of the Works;
- (d) we have examined and have no reservations to the Tender Document, issued by you on *[insert date]*; including Addendum to Tender Document No(s) *[state numbers]*, issued in accordance with the Instructions to Tenderers (ITT Clause 11). *[insert the number and issuing date of each addendum; or delete this sentence if no Addendum has been issued]*;
- (e) we, including as applicable, any JV partner or Subcontractor for any part of the contract resulting from this Tender process, have nationalities from eligible countries, in accordance with ITT Sub Clause 5.1;
- (f) we are submitting this Tender as a sole Tenderer in accordance with ITT Sub Clause 19.1
or
 we are submitting this Tender as the partners of a JV, comprising the following other partners in accordance with ITT Clause 17;

	Name of Partner	Location & District of Partner
1		
2		
3		
4		

- (g) *we are not a Government owned entity as defined in ITT Sub Clause 5.10*
or
we are a Government owned entity, and we meet the requirements of ITT Sub Clause 5.10;
- (h) we, including as applicable any JV partner, declare that we are not associated, nor have been associated in the past, directly or indirectly, with a consultant or any other entity that has prepared the design, specifications and other documents in accordance with ITT Sub Clause 5.6;
- (i) we, including as applicable any JV partner or Subcontractor for any part of the contract resulting from this Tender process, have not been declared ineligible by the Government of Bangladesh on charges of engaging in corrupt, fraudulent, collusive, coercive or obstructive practices in accordance with ITT Sub Clause 5.7;
- (j) furthermore, we are aware of ITT Clause 4 concerning such practices and pledge not to indulge in such practices in competing for or in executing the Contract;
- (k) we intend to subcontract an activity or part of the Works, in accordance with ITT Clause 18.1 to the following Subcontractor(s);

Activity or part of the Plant and Services	Name of Subcontractor with Location and District

- (l) we, including as applicable any JV partner, confirm that we are not currently suspended or debarred in connection with ITT Clause 5.8,
- (m) we are not participating as Tenderer in more than one Tender in this Tendering process. We understand that your written Notification of Award shall constitute the acceptance of our Tender and shall become a binding Contract between us, until a formal Contract is prepared and executed;
- (n) we, including as applicable any JV partner, confirm that we do not have a record of insolvency, receivership, bankrupt or being wound up, our business activities were not been suspended, and it was not been the subject of legal proceedings in accordance with ITT Sub Clause 5.9;
- (o) we, including as applicable any JV partner, confirm that we have fulfilled our obligations to pay taxes and social security contributions applicable under the relevant national laws and regulations of Bangladesh in accordance with ITT Sub Clause 5.5;
- (p) we understand that you reserve the right to reject all the Tenders or annul the Tender proceedings, without incurring any liability to Tenderer, in accordance with ITT Clause 60.

Signature:	<i>[insert signature of authorised representative of the Tenderer]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
In the capacity of:	<i>[insert capacity of signatory]</i>
Duly authorised to sign the Tender for and on behalf of the Tenderer	

[If there is more than one (1) signatory, or in the case of a JV, add other boxes and sign accordingly].

Attachment 1:

[ITT Sub Clause 39.4]

Written confirmation authorising the above signatory(ies) to commit the Tenderer

[and, if applicable]

Attachment 2:

[ITT Sub Clause 28.2(b)]

Copy of the JV Agreement / Letter of Intent to form JV with draft proposed Agreement

Letter of Authorization (Form PG5A-1A)

[This is the format for the Letter of Authorization submitted by the tenderer in accordance with ITT Clause 39.4]

Invitation for Tender No:

Date:

Tender Package No:

Lot No (*when applicable*)

To:

[Name and address of the Procuring Entity]

I/We, the undersigned, as the Sole Proprietor/Authorized Partner/Partner-in-Charge/Managing Director/Chairman/Chief Executive Officer of the firm titled *[Insert Name and Address of the firm]*, do hereby authorize *[Insert name, designation, address and NID of the person being authorized]* to sign all the documents related with the tender on behalf of the firm. His/her specimen signatures are given below:

(signature)

1.....

(signature)

2.....

(signature)

3.....

Date:

(Signature)

Name, designation, address and NID

Note:

1. Relevant documentary evidence of authorizing capacity of the signatory of this authorization letter shall be attached.

Tenderer Information (Form PG5A-2)

[This format shall be completed and signed by the Tenderer or his/her Authorised Signatory, without alterations, on the Letter-head pad of the Tenderer]

Invitation for Tender No:

IFT No]

Tender Package No:

[Package No]

Lot No (*when applicable*)

[Lot No)]

1. Eligibility Information of the Tenderer [ITT –Clauses 5 & 28]		
1.1	Nationality of individual or country of registration	
1.2	Tenderer's legal title	
1.3	Tenderer's registered address	
1.4	Tenderer's legal status <i>[complete the relevant box]</i>	
	Proprietorship (Please mention name and NID of the proprietor)	
	Partnership (Please mention name and NID of the partners)	
	Limited Liability Concern (Please mention name and NID of CEO or MD and the Directors (members of Board of Directors) and/ or Shareholders (at least 10% shares) of the concern)	
	Government-owned Enterprise	
	Others [please describe, if applicable]	
1.5	Tenderer's year of registration	
1.6	Tenderer's authorised representative details	
	Name	
	National ID number	
	Address	
	Telephone / Fax numbers	
	e-mail address	
1.7	Litigation [ITT Sub Cause 14.1(a)]	

	A. No pending litigation ☐ [if no pending litigation put Tick Mark in Box]			
	B. Pending litigation			
	Month/Year	Matter in dispute	Value of Pending Claim in Taka	
1.8	Tenderer to attach photocopies of the original documents mentioned aside		[All documents required under ITT Clauses 5 and 28]	
The following two information are applicable for National Tenderers				
1.9	Tenderer's Value Added Tax Registration (VAT) Number			
1.10	Tenderer's Tax Identification Number (TIN)			
[The foreign Tenderers, in accordance with ITT Sub Clause 5.1, shall provide evidence by a written declaration to that effect to demonstrate that it meets the criterion]				
2. Qualification Information of the Tenderer [ITT Clause 31]				
2.1	General Experience in the Supply of Goods [State years of experience]			
2.2	Specific Experience of satisfactory completion of supply of similar Goods			
	Contract No		[insert reference no] of [insert year]	
	Name of Contract		[insert name]	
	Role in Contract [tick relevant box].		Prime Contractor	Subcontractor
	Award date		[insert date]	
	Completion date		[insert date]	
Total Contract Value		[insert amount]		
Procuring Entity's Name Address Tel <u>e-mail</u>				
Brief description with justifications of the similarity compared to the Procuring Entity's requirements		[state justification in support of its similarity compared to the proposed supply]		

2.3	Supply and/or production capacity of Goods are:		
	Year	Quantity	Type of Goods

2.4	Liquid assets available [ITT Sub Clause 14.1(b)]		
	No	Source of Financing	Amount Available
In order to confirm the above statements, the Tenderer shall submit, as applicable, the documents mentioned in ITT Sub Clause 31.1(d)			
2.5	Contact Details [ITT Sub Clause 31.1 (f)]		
	Name, address, and other contact details of Tenderer Bankers and other Procuring Entity(s) that may provide references, if contacted by this Procuring Entity		

JV Partner Information (Form PG5A-2b)

[This Form should be completed and signed by each JV partner without alterations, preferably on its Letter-Head Pad]

I

Invitation for Tender No:

[IFT No]

Tender Package No:

Package No]

Lot No. (*when applicable*)

[Lot No)]

1.	Eligibility Information of the JV Partner [ITT –Clauses 5 & 28]	
1.1	Nationality of individual or country of registration	
1.2	JV Partner's legal title	
1.3	JV Partner's registered address	
1.4	JV Partner's legal status <i>[complete the relevant box]</i>	
	Proprietorship (Please mention name and NID of the proprietor)	
	Partnership (Please mention name and NID of the partners)	
	Limited Liability Concern (Please mention name and NID of CEO or MD and the Directors (members of Board of Directors) and/ or Shareholders (at least 10% shares) of the concern)	
	Government-owned Enterprise	
1.5	JV Partner's year of registration	
1.6	JV Partner's authorised representative details	
	Name	
	National ID number	
	Address	
	Telephone / Fax numbers	
	e-mail address	
1.7	Litigation [ITT Cause 13]	

	A. No pending litigation ☐ [if no pending litigation put Tick Mark in Box]			
	B. Pending litigation			
	Year	Matter in dispute	Value of Pending Claim in Taka	Value of Pending Claim as Percentage of Net Worth
1.8	JV Partner to attach photocopies of the original documents mentioned aside		[All documents required under ITT Clauses 5 and 29]	
The following two information are applicable for national JV Partners only				
1.9	JV Partner's Value Added Tax Registration (VAT) Number			
1.10	JV Partner's Tax Identification Number (TIN)			
[The foreign JV Partners, in accordance with ITT Sub Clause 5.1, shall provide evidence by a written declaration to that effect to demonstrate that it meets the criterion]				
2.	Key Activity(ies) for which it is intended to be joint ventured, if it can be specified [ITT Sub Clause 17.2]			
	Elements of Activity		Brief description of Activity	
3.	Qualification Information of the JV Partners [ITT Clause 31]			
3.1	General Experience in Construction Works of JV Partners [State years of experience]			
3.2	Specific Experience in Construction Works of JV Partners Completed Contracts of similar nature, complexity and methods/construction technology			
	Contract No	[insert reference no] of [insert year]		
	Name of Contract	[insert name]		
	Role in Contract [tick relevant box].	Prime Contractor	Subcontractor	Management Contractor
	Award date	[insert date]		
	Completion date	[insert date]		
	Total Contract Value	[insert amount]		
	Procuring Entity's Name Address Tel / Fax <u>e-mail</u>			
	Brief description with justifications of the	[state justification in support of its similarity compared to the		

	similarity compared to the Procuring Entity's requirements	proposed works]

3.3 Average Annual Construction Turnover

[Select one option from below and delete the italics]

[Option 1: Based on Profit and Loss Account or Audit Report duly conducted by Registered Chartered Accountancy Firm, Exchange Rate shall be rate at the end of the period reported by the concerned central bank of the country]

Period or Year	Amount and Currency	Amount in Equivalent BDT.
1	2	3

Option 2: Based on total certified payments received for contracts in progress or completed under public sector for a period as stated under ITT Sub Clause 14.1(b) [applicable for local tenderer]

Sl.	Period or Year	Tender ID or Ref. No.	Received Date	Amount	Business Share	Turnover
1	2	3	4	5	6	7
					Total	
					AACT	

3.4	Liquid assets available to meet the construction cash flow [ITT Sub Clause 14.1(b)]			
	No	Source of Financing		Amount Available
In order to confirm the above statements, the JV Partners shall submit, as applicable, the documents mentioned in ITT Sub Clause 31.1(d)				
3.5	Contact Details [ITT Sub Clause 31.1 (f)]			
	Name, address, and other contact details of JV Partner's Bankers and other Procuring Entity(s) that may provide references, if contacted by this Procuring Entity			
3.6	Qualifications and experience of key technical and administrative personnel proposed for Contract administration and management [ITT Sub Clause 31.1(h)]			
	Name	Position	Years of General Experience	Years of Specific Experience

[JV Partners <i>to complete details of as many personnel as are applicable. Each personnel listed above should complete the Personnel Information (Form PG5A-2b)</i>]			
3.7	Major Construction Equipment proposed to carry out the Contract [ITT Sub Clause 31.1(i)]		
	Item of Equipment	Condition (new, good, average, poor)	Owned, leased or to be purchased (state owner, lessor or seller)
<i>[Tenderer to list details of each item of major construction equipment, as applicable]</i>			

Name:	<i>[insert full name of signatory]</i>	<i>Signature with Date and Seal</i>
In the capacity of:	<i>[insert designation of signatory]</i>	<i>[Sign]</i>
Duly authorized to sign the Tender for and on behalf of the Tenderer		

Subcontractor Information Form (Form PG5A-2c)

[This Form should be completed and signed by each Subcontractor, without alterations, preferably on its Letter-Head Pad]

Invitation for Tender No:

[IFT No]

Tender Package No

[Package No]

Lot No. (when applicable)

[Lot No]

1. Eligibility Information of the Subcontractor <i>[ITT –Clauses 5 & 28]</i>		
1.1	Nationality of Individual or country of Registration	
1.2	Subcontractor's legal title	
1.3	Subcontractor's registered address	
1.4	Subcontractor's legal status <i>[complete the relevant box]</i>	
	Proprietorship (Please mention name and NID of the proprietor)	
	Partnership (Please mention name and NID of the partners)	
	Limited Liability Concern (Please mention name and NID of CEO or MD and the Directors (members of Board of Directors) and/ or Shareholders (at least 10% shares) of the concern)	
	Government-owned Enterprise	
1.5	Subcontractor's year of registration	
1.6	Subcontractor's authorised representative details	
	Name	
	Address	
	Telephone numbers	
	e-mail address	
1.7	Subcontractor to attach copies of the following original documents	All documents to the extent relevant to ITT Clause 5 and 28 in support of its qualifications
The following two information are applicable for national Subcontractors		
1.8	Subcontractor's Value Added Tax Registration (VAT) Number	

1.9	Subcontractor's Tax Identification Number (TIN)		
[The foreign Subcontractors, in accordance with ITT sub Clause 5.1, shall provide evidence by a written declaration to that effect to demonstrate that it meets the criterion]			
2. Key Activity(ies) for which it is intended to be Subcontracted [ITT Sub Clause 18.1]			
2.1	Elements of Activity	Brief description of Activity	
2.2	List of Similar Contracts in which the proposed Subcontractor had been engaged		
	Name of Contract and Year of Execution		
	Value of Contract		
	Name of Procuring Entity		
	Contact Person and contact details		
	Type of Work performed		

Price Schedule for Plant and Service (Form PG5A-3)

(This form should be completed and submitted by the tenderer and appended in the financial proposal envelope)

Invitation for Tender No:	<i>[indicate IFT No]</i>
Tender Package No	<i>[indicate Package No]</i>
This Package is divided into the following Number of Lots	<i>[indicate number of Lot(s)]</i>

General

1. The Price Schedules are divided into separate Schedules as follows:

Schedule No. 1: Plant and Mandatory Spare Parts.

Schedule No. 2: Installation and Other Services.

Schedule No. 3: Grand Summary.

2. The Schedules do not generally give a full description of the plant to be supplied and the services to be performed under each item. Tenderers shall be deemed to have read the Procuring Entity's Requirements and other sections of the Tender Document and reviewed the Drawings 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.
3. If tenderers are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITT 9.1 prior to submitting their tender.

Pricing

4. Prices shall be filled in indelible ink, and any alterations necessary due to errors, etc., shall be initialed by the Tenderer.
As specified in the Tender Data Sheet and Special Conditions of Contract, prices shall be fixed and firm for the duration of the Contract, or prices shall be subject to adjustment in accordance with the corresponding Appendix (Price Adjustment) to the Contract Agreement.
5. Tender prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Tenderers in the Tender Document.
For each item, tenderers shall complete each appropriate column in the respective Schedules, giving the price breakdown as indicated in the Schedules.
Prices given in the Schedules against each item shall be for the scope covered by that item as detailed in Section 6 (Procuring Entity's Requirements) or elsewhere in the Tender Document.
6. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.
7. When requested by the Procuring Entity for the purposes of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Procuring Entity may reasonably require, the Contractor shall provide the Procuring Entity with a breakdown of any composite or lump sum items included in the Schedules.

TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1.

Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1

Schedule No.1: Plant and Mandatory Spare Parts

SI No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
1	Supply of Hot dip galvanized steel structure Gantry (10 nos. 10 meter tower, 21 nos. beams, 2 nos LAPI, 5 nos. VCB, 5 nos CT, 2 nos EM Tower steel structure) with all necessary accessories for installation of equipment as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Lot	1		
2	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Incoming feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2		
3	Supply of Control Relay Panel for 33KV Incoming feeder having Directional relay, instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT and Energy meters (accuracy-0.2s) 3 nos digital ammeter, 1 nos digital Voltmeter, 1 nos MFM as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2		
4	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Outgoing feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	1		
5	Supply of Control Relay Panel for 33KV Outgoing feeder having instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT and Energy meters (accuracy-0.2s) three nos digital ammeter, 1 nos digital Voltmeter, 1 nos MFM as per approved design & drawing and instruction of Engineer-in-charge.	Nos	1		
6	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Transformer -Incoming feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2		

Sl No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
7	Supply of 33KV Control Relay Panel for Transformer -Incoming feeder having instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT, Differential Relay and Energy meters (accuracy-0.2s) three nos digital ammeter, digital Voltmeter, digital Wattmeter, digital VAR meter, digital Power Factor meter, digital Watthour meter as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2		
8	Supply of 33/11 KV, 20/28 MVA, OLTC Power Transformer with RTCC Control Panel and all necessary accessories including 33 & 11 KV Surge arrester as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2		
9	Supply of 33KV, Single Phase Lightning Arrestor (Zno Type) as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Nos.	12		
10	Supply of 33KV, Isolator (1250A 31.5 kA, 3s) without Earth Blade for Incoming feeders at Bus side as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	3		
11	Supply of 33KV Isolator (1250A 31.5 kA, 3s) with Earth Blade for Incoming feeders at load side as per approved design & drawing and instruction of engineer-in-charge / Employer.	Sets	3		
12	Supply of 33KV, Isolator (1250A 31.5 kA, 3s) without Earth Blade for outgoing feeders at Bus side as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2		
13	Supply of 33KV, Isolator (2500A 31.5 kA, 3s Twin martin) without Earth Blade for Bus-Section as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1		
14	Supply of 33kV Single Phase Current Transformer for incoming feeder where core-1 (1600-800:5A, 0.2S, 30VA) is for indicating meters on control and relay panel, core-2 (1600-800:5A, 0.2S, 30VA) is for energy meters and Core-3 (1600-800:5A, 5P20, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos.	6		
15	Supply of 33kV Single Phase Current Transformer for transformer feeder where core-1 (800-400:5A, 0.2S, 30VA) is for indicating meters and energy meters on control and relay panel and core-2 & 3 (800-400:5-5A, 0.2S, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos.	6		

Sl No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
16	Supply of 33kV Single Phase Current Transformer for outgoing feeder where core-1 (800-400:5A, 0.2S, 30VA) is for indicating meters on control and relay panel, core-2 (800-400:5A, 0.2S, 30VA) is for energy meters and Core-3 (800-400:5A, 5P20, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos	3		
17	Supply of 33KV, Single Phase Voltage Transformer PT 33000/√3:110/√3:110/√3, Secondary winding for core-1 accuracy class-0.2, burden 50 VA dedicated for metering and for core-2 accuracy class-3P, burden 50 VA as per approved design & drawing and instructions Engineer-in-charge /Employer.	Nos.	12		
18	Supply of 11KV indoor Switchgear VCB (2000 Amps, 31.5kA, 3s) for 11KV Incoming-Feeder with inbuilt CT (2000-1000:5-5-5A) where Core-1 (CL-0.2, 20VA) dedicated for Metering, Core-2&3 (20VA, CL-5P20) dedicated for protection including Digital Master Relay, Trip relay, Directional relay, 2 nos Trip circuit supervision Relay, Energy meter (Accuracy-0.2s) with Export and Import and 03 Nos digital Ammeter, 1 nos volt meter, 1 nos MFM etc. with in-built 11 KV 2500 Amps copper bus-bar where closing and tripping coil must be operated by 110 Volt DC . in control room building inbuilt 11KV PT (11000/√3:110/√3:110/√3) as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	2		
19	Supply of 11KV indoor Switchgear, VCB (2000 Amps, 31.5kA, 3s) for 11KV Bus-Coupler including Bus riser with inbuilt CT (2000-1000:5-5A) where Core-1 (CL-0.2, 20VA) dedicated for Metering panel & core-2 (20VA, 5P20) dedicated for protection including digital meter relay, trip relay, 2 nos trip ckt supervision relay and 3 nos digital ammeter 1 nos volt meter, 1 nos MFM etc. with inbuilt 11KV 2500A copper Bus bar where closing and tripping coil must be operated by 110 Volt DC as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	1		

Sl No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
20	Supply of 11KV indoor Switchgear/ VCB (630 Amps, 31.5kA, 3s) for 11KV Outgoing Feeder with inbuilt CT (600-300:5-5A) in control room building where Core-1(CL-0.2, 20VA) dedicated for Metering panel & core-2(20VA, 5P20) dedicated for protection including digital meter relay, trip relay, 2 nos trip ckt supervision relay, energy meter (Accuracy-0.2s) with export & import and 3 nos digital ammeter, 1 nos volt meter, 1 nos MFM etc. with inbuilt 11KV 2500A copper Bus bar where closing and tripping coil must be operated by 110 Volt DC as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	10		
21	Supply of 11KV indoor Bus PT (11000/√3:110/√3:110/√3) inbuilt with switchgear in control room building.as per approved design & drawing and instruction of Engineer-in-charge /Employer. (1 set= 3 nos)	Sets	2		
22	Supply of 11KV, Single Phase Lightning Arrestor (Zno Type) as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Nos	30		
23	Supply of Battery (250Ah, 110V DC) and 02 Nos Battery Charger (minimum 70A) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Sets	1		
24	Supply of 33/0.415KV Auxiliary 100KVA Transformer as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2		
25	Supply of 33KV Drop out Fuse Isolator for 33/0.415KV 100KVA Auxiliary Transformer as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1		
26	Supply of AC Distribution Panel as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1		
27	Supply of DC Distribution Panel as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1		
28	Supply of Miscellaneous equipment including multicore armour control cables required for works, earthing materials, 33 kV Bus-bar (4 new Span, 2500A) including loop conductor & Connector, Insulator & other related required fittings, LV cables, MK Box, sub-station lighting etc as per approved design & drawing and instruction of Engineer-in-charge.	Lot	1		

Sl No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
29	Supply of Furniture for Control Room, Office Room, Complain Center, Rest room (1 nos. executive table, 1 nos. executive chair, 6 nos. visiting chair, 1 nos. file cabinet, 1 nos. file rack, 1 set (5 seated sofa), 1 set computer table & chair. as required) as per approved design & drawing and instruction of Engineer-in charge /Employer.	Lot	1		
30	Supply of Air Conditioning System (each 2.5 Ton) for Control Room including all accessories/ components required for fitting & fixing up to commissioning as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos.	5		
31	Supply of Desktop Computer including all accessories/components (Monitor, CPU, Printer, UPS and etc.) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Set	1		
32	Supply of Laptop Computer including all accessories/ components as per instruction of Engineer-in-charge /Employer.	Nos.	1		
33	Supply of submersible water Pump Motor Set with 4 inch dia suction, 2000 liter water tank including all accessories/ components required for fitting & fixing up to Commissioning (complete in all respect for drinkable water) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Set	1		
34	Supply of Fire Detection & Protection Facilities for control room building including all accessories/ components required for fitting & fixing up to Commissioning as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1		
35	Supply of Substation Automation System as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1		
36	Supply of Demo SAS (Substation Automation System) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1		
Sub-Total of Schedule-1=					

In word:

Note: 1. All Costs of Equipment shall include Design, Manufacture, Transportation to site including Insurance, VAT & all other Taxes (as applicable in the Employer's Country).
2. All Costs of Works shall include Cost of Works including Insurance, VAT income Tax & all other Taxes (as applicable in the Employer's Country).
3. All costs shall include the items / components as detailed in the document.
4. All IED's and meters shall be compatible with IEC 61850 protocol.
5. Approx. 800m 11kV 3C185mm² Power Cable, Approx. 600m 11kV 1C500mm² Power Cable and required termination kits will be supplied by PBS.

Seal and signature of the Tenderer

TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1.

Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1

Schedule No. 2- Installation and Other Services

SI No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
1	Testing & Commissioning.	Lot	1		
2	All installation including installation of substation earthing and lighting (as required), all electrical equipments (VCB, CRP, CT/PT, Power Transformer, Isolator, LA, Battery, Battery Charger etc.) steel structure, cable laying, cable termination and other as required.	Lot	1		
3	Dismantling of existing outdoor substation unit and return the materials to PBS Store as per instruction of Engineer-in-charge/ Employer	Lot	1		
4	Site Development/Improvement by carted earth or sand, sandy silt (free from any organic, foreign, environmental hazardous substances) carried by head or truck or any other means in/c cost of cutting or by dredging of sand, sandy silt, all; in/c local carrying, placing the earth/sand, sandy silt in the designated area, maintaining slopes, breaking lumps, levelling and dressing in layers up to finished level etc. With Mechanical compaction of earth beyond plinth area, required for per-approved specific engineering purpose in 150 mm layers including leveling, watering and consolidation each layer.	Cum	1000		
5	Supply materials and construction of Two (02) storied Control Room (10m*18m) Building (Three Storied Foundation) including guard house as per approved design & drawing and direction of Engineer-in-charge.	sq.m	380		
6	Supply materials and Construction of Foundation of all Equipments and gantry Structure as per approved design & drawing and direction of Engineer-in-charge.	Lot	1		
7	Surface Finishing with gravels for new Switchyard area as per approved design & drawing and direction of Engineer-in-charge.	sq.m	220		
8	Supply materials and construction of approach & internal road as per approved design and drawing and direction of the engineer in charge	sq.m	120		
9	Supply materials and construction of surface drain as per approved design and drawing and direction of the Engineer in charge.	Rm	106		
10	Supply materials and construction of Fencing as per approved design and drawing and direction of the Engineer in charge.	Rm	150		

Sl No.	Description	Unit	Qty	Unit price (in BDT)	Total Price (in BDT)
11	Supply materials and construction of RCC Cable Trench for power cable laying as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Rm	60		
12	Supply materials and construction of RCC Cable Trench for control Cable laying as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Rm	80		
Sub-Total of Schedule-2=					

In word:

Note: 1. All Costs of Equipment shall include Design, Manufacture, Transportation to site including Insurance, VAT & all other Taxes (as applicable in the Employer's Country).
2. All Costs of Works shall include Cost of Works including Insurance, VAT income Tax & all other Taxes (as applicable in the Employer's Country).
3. All costs shall include the items / components as detailed in the document.
4. All IED's and meters shall be compatible with IEC 61850 protocol.
5. Approx. 800m 11kV 3C185mm² Power Cable, Approx. 600m 11kV 1C500mm² Power Cable and required termination kits will be supplied by PBS.

Seal and signature of the Tenderer

TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 2X20/28 MVA PALASHBARI (HQ) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1.

Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1

Schedule No. 3- Grand Summary

SI No.	Description	Total Price (in BDT)
1	Sub-Total of Schedule No. 1- Plant and Mandatory Spare Parts	
2	Sub-Total of Schedule No. 2- Installation and other services	
Grand Total=		
In word: Note: 1. All Costs of Equipment shall include Design, Manufacture, Transportation to site including Insurance, VAT & all other Taxes (as applicable in the Employer's Country). 2. All Costs of Works shall include Cost of Works including Insurance, VAT income Tax & all other Taxes (as applicable in the Employer's Country). 3. All costs shall include the items / components as detailed in the document. 4. All IED's and meters shall be compatible with IEC 61850 protocol. Seal and signature of Tenderer		

Name:	<i>[insert full name of signatory]</i>	<i>Signature with Date and Seal</i>
In the capacity of:	<i>[insert designation of signatory]</i>	<i>[Sign]</i>
Duly authorized to sign the Tender for and on behalf of the Tenderer		

Technical Proposal (Form PG5A-4)

[The Revised Technical Proposal, if any, shall follow the same format and structure]

Site Organization

Method Statement

Mobilization Structure

Construction Structure

Plant

Safety Plan

Personnel

Equipment

Proposed subcontractors for Major Items of Plant and Services

Time Schedule

Site Organization

[insert technical proposal for site organization]

[The Tenderer shall include in the tender an appropriate organization chart. This shall include head office as well as site components and clearly demonstrate that the Tenderer possesses the staff and organizational resources to complete the Supply and Installation of Plant & Equipment.]

Method Statement

[insert technical proposal for Method Statement]

*[The Tenderer shall furnish an overall description covering all activities and processes from inception to site works and commissioning.
In particular methods of minimizing the impact on the environment in accordance with the relevant laws and regulations during the construction phase shall be described.]*

Mobilization Schedule

[insert technical proposal for Mobilization Schedule]

[This shall be included in the overall time schedule to be provided by the Tenderer as per "Time Schedule" in Section 5.Tendering Forms]

Construction Schedule

[insert technical proposal for Construction Schedule]

[This shall be included in the overall time schedule to be provided by the Tenderer as per "Time Schedule" in Section5. Tendering Forms]

Plant

*[insert technical proposal for **Plant**]*

[The Tenderer shall provide the plant and equipment it intends to use in the construction process to demonstrate that it has the capability to complete the Supply and Installation of Plant & Equipment.]

Safety Plan

*[insert technical proposal for **Safety Plan**]*

[The Tenderer shall demonstrate that it has a comprehensive safety system that will be used during the construction and installation phase. This system shall meet all safety requirements in accordance with all relevant laws, rules and regulations.]

Personnel Information

[This Form should be completed for each person proposed by the Tenderer on Form PG5A-2a& PG5A-2b, where applicable]

Invitation for Tender No:	<i>[IFT No]</i>
Tender Package No	<i>[Package No]</i>
Lot No. (<i>when applicable</i>)	<i>[Lot No]</i>

A. Proposed Position (tick the relevant box)			
☐ Construction Project Manager	☐ Prime Candidate	☐ Alternative Candidate	
☐ Key Personnel	☐ Prime Candidate	☐ Alternative Candidate	
B. Personal Data			
Name			
Date of Birth			
Years overall experience			
National ID Number			
Years of employment with the Tenderer			
Professional Qualifications:			
1.			
C. Present Employment <i>[to be completed only if not employed by the Tenderer]</i>			
Name of Procuring Entity (working under):			
Address of Procuring Entity (working under):			
Present Job Title:			
Years with present Procuring Entity:			
Tel No:	Fax No:	e-mail address:	
Contact <i>[manager/personnel officer]</i> :			
D. Professional Experience			
Summarise professional experience over the past twenty years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.			
	From	To	Company / Project / Position / Relevant technical and management experience.
1			
2			

Name:	<i>[insert full name of signatory]</i>	<i>Signature with Date and Seal</i>
In the capacity of:	<i>[insert designation of signatory]</i>	<i>[Sign]</i>

Equipment Information

[The Tenderer shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in TDS . A Separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Tenderer]

Invitation for Tender No:	<i>[indicate IFT No]</i>
Tender Package No	<i>[indicate Package No]</i>
This Package is divided into the following Number of Lots	<i>[indicate number of Lot(s)]</i>

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Tenderer.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

Name:	<i>[insert full name of signatory]</i>	<i>Signature with Date and Seal</i>
In the capacity of:	<i>[insert designation of signatory]</i>	<i>[Sign]</i>
Duly authorised to sign the Tender for and on behalf of the Tenderer		

Proposed Subcontractors for Major Items of Plant and Installation Services

A list of major items of Plant and Installation Services is provided below.

The following Subcontractors and/or manufacturers are proposed for carrying out the item of the facilities indicated. Tenderers are free to propose more than one for each item

Major Items of Plant and Installation Services	Proposed Subcontractors/Manufacturers	Nationality

Form Functional Guarantee

The Tenderer shall copy in the left column of the table below, the identification of each functional guarantee required in the Specification and stated by the Procuring Entity in ITT 24(n) and in the right column, provide the corresponding value for each functional guarantee of the proposed plant and equipment.

Invitation for Tender No:	<i>[indicate IFT No]</i>
Tender Package No	<i>[indicate Package No]</i>
This Package is divided into the following Number of Lots	<i>[indicate number of lot(s)]</i>

Required Functional Guarantee	Value of Functional Guarantee of the Proposed Plant and Equipment
1.	
2.	
3.	
4.	
5.	
6.	

Specifications Submission and Compliance Sheet (Form PG5A-5)

Invitation for Tender No:

Tender Package No:

Date:

Package Description: *[enter description as specified in Section 6]*

Tender Lot No:

Lot Description: *[enter description as specified in Section 6]*

Item No.	Name of Goods or Related Service	Country of Origin	Make and Model (<i>when applicable</i>)	Full Technical Specifications and Standards
1	2	3	4	5
	FOR GOODS			Note 1
	FOR RELATED SERVICES			

[The Tenderer should complete all the columns as required]

Signature:	<i>[insert signature of authorised representative of the Tenderer]</i>
Name:	<i>[insert full name of signatory with National ID]</i>
In the capacity of:	<i>[insert designation of signatory]</i>
Duly authorised to sign the Tender for and on behalf of the Tenderer	

Manufacturer's Authorisation Letter (Form PG5A - 6)

[The Tenderer shall require the Manufacturer to fill in this Form in accordance with the instructions indicated. This letter of authorization should be on the letterhead of the Manufacturer and should be signed by a person with the proper authority to sign documents that are binding on the Manufacturer.]

[The Tenderer shall include it in its Tender, if so indicated in the TDS as stated under ITT Sub Clause 31.1 (e)]

Invitation for Tender No:	Date:
Tender Package No:	
Tender Lot No(<i>when applicable</i>):	
To: [Name and address of Procuring Entity]	

WHEREAS

We *[insert complete name of Manufacturer]*,

who are official manufacturers of *[insert type of goods manufactured]*, having factories at *[insert full address of Manufacturer's factories]*, do hereby

authorize *[insert complete name of Tenderer]* to supply the following Plant and Equipment, manufactured by us *[insert name and or brief description of the Goods]*.

We hereby extend our full guarantee and warranty as stated under GCC Clause 45 of the General Conditions of Contract, with respect to the Goods offered by the above Tenderer.

Signed: *[insert signature(s) of authorized representative(s) of the Manufacturer]*

Name: *[insert complete name(s) of authorized representative(s) of the Manufacturer]*

Address: *[insert full address including Fax and e-mail]*

Title: *[insert title]*

Date: *[insert date of signing]*

Bank Guarantee for Tender Security (Form PG5A-7)

[This is the format for the Tender Security to be issued by any scheduled Bank of Bangladesh without alteration, in accordance with ITT Clause 34 & 35]

Invitation for Tender No:

Date:

Tender Package No:

Lot No (*when applicable*)

To:

[Name and address of the Procuring Entity]

TENDER GUARANTEE No: [insert number]

We have been informed that *[name of Tenderer]* (hereinafter called “the Tenderer”) intends to submit to you its Tender dated *[date of Tender]* (hereinafter called “the Tender”) for the supply of *[description of Goods]* under the above Invitation for Tenders (hereinafter called “the IFT”).

Furthermore, we understand that, according to your conditions, the Tender must be supported by a Bank Guarantee for Tender Security.

At the request of the Tenderer, we *[name of Bank]* hereby irrevocably unconditionally undertake to pay you, without cavil or argument, any sum or sums not exceeding in total an amount of Tk *[insert amount in figures and words]* upon receipt by us of your first written demand accompanied by a written statement that the Tenderer is in breach of its obligation(s) under the Tender conditions, because the Tenderer:

- a. has withdrawn its Tender after opening of Tenders but within the validity of the Tender Security; or
- b. failed to furnish Performance Security within the period stipulated in the NOA; or
- c. refused to sign the Contract Agreement by the time specified in the NOA; or
- d. did not accept the correction of the Tender price following the correction of the arithmetic errors as stated under ITT.
- e. involves in any corrupt, fraudulent, collusive, coercive or obstructive practice of any kind as defined in ITT Clause 4.

This guarantee will expire

- (a) if the Tenderer is the successful Tenderer, upon our receipt of a copy of the Contract Agreement signed by the Tenderer or a copy of the Performance Security issued to you in accordance with the ITT; or
- (b) if the Tenderer is not the successful Tenderer, twenty-eight (28) days after the expiration of the Tenderer’s Tender Validity period, being *[date of expiration of the Tender Validity plus twenty-eight (28) days]*.

Consequently, we must receive at the above-mentioned office any demand for payment under this guarantee on or before that date.

Signature

Signature

Letter of Commitment for Bank's Undertaking for Line of Credit (Form PG5A-8)

[This is the format for the Credit Line to be issued by any scheduled Bank of Bangladesh, without alterations, in accordance with ITT Clause 31.1(d).]

Invitation for Tender No:

Date:

Tender Package No:

Lot No (*when applicable*)

To:

[Name and address of the Procuring Entity]

CREDIT COMMITMENT No: [insert number]

We have been informed that *[name of Tenderer]* (hereinafter called "the Tenderer") intends to submit to you its Tender (hereinafter called "the Tender") for the execution of the Supply of *[description of Goods]* under the above Invitation for Tenders (hereinafter called "the IFT").

Furthermore, we understand that, according to your conditions, the Tenderer's Financial Capacity i.e. Liquid Asset must be substantiated by a Letter of Commitment of Bank's Undertaking for Line of Credit.

At the request of, and arrangement with, the Tenderer, we *[name and address of the Bank]* do hereby agree and undertake that *[name and address of the Tenderer]* will be provided by us with a revolving line of credit, in case awarded the Contract, for the delivery of Goods viz. *[insert name of Goods]*, for an amount not less than BDT *[in figure]* (*in words*) for the sole purpose of the execution of the above Contract. This Revolving Line of Credit will be maintained by us until issuance of "Acceptance Certificate" by the Procuring Entity.

In witness whereof, authorised representative of the Bank has hereunto signed and sealed this Letter of Commitment.

Signature

Signature

Notification of Award (Form PG5A-9)

Reference No:

Date:

To:

[Name of the successful tenderer]

This is to notify you that your Tender dated [*insert date*] for the supply of the Goods for [*name of Contract*] for the Contract Price of BDT [*state amount in figures and in words*] as evaluated in accordance with the Instructions to Tenderers, has been approved by the competent authority. You are, thus, requested to take following actions:

- i. furnish a Performance Security in the specified format and in the amount of Tk [*state amount in figures and words*], within [*mention number of days as per Rule 123(7)*] working days of issuance of this letter but no later than [*specify the date of the last working day of the allowed time*] in accordance with ITT Clause No 66;
- ii. sign the Contract within [*mention number of days as per Rule 123(11)*] days of issuance of this letter but no later than [*specify the date of the last working day of the allowed time*] in accordance with ITT Clause 71.

You may proceed with the supply of the Goods only upon completion of the above tasks. You may also please note that this Notification of Award shall constitute the formation of this Contract which shall become binding upon you.

We attach the draft Contract and all other documents for your perusal and signature.

Signed
Duly authorized to sign for and or behalf of
[name of Procuring Entity]
Date:

Contract Agreement (Form PG5A-10)

THIS AGREEMENT made the *[day]* day of *[month]/[year]* between *[name and address of Procuring Entity]* (hereinafter called "the Procuring Entity") of the one part and *[name and address of Contractor]* (hereinafter called "the Contractor") of the other part:

WHEREAS the Procuring Entity invited Tenders for certain goods and related services, viz, *[brief description of goods]* and has accepted a Tender by the Contractor for the execution of those Goods in the sum of Taka *[Contract Price in figures and in words]* (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 General Conditions of Contract hereafter referred to.
2. The documents forming the Contract shall be interpreted in the following order of priority:
 - (a) the signed Contract Agreement
 - (b) the Notification of Award
 - (c) the completed Tender and the Appendix to the Tender
 - (d) the Particular Conditions of Contract
 - (e) the General Conditions of Contract
 - (f) the Technical Specifications
 - (g) the General Specifications
 - (h) the Drawings
 - (i) the Priced Schedules of Plant and Equipment
 - (j) any other document including correspondence listed in the **PCC** forming part of the Contract.
3. In consideration of the payments to be made by the Procuring Entity to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Entity to provide the plants and related services and to remedy any defects therein in conformity in all respects with the provisions of the Contract.
4. The Procuring Entity hereby covenants to pay the Contractor in consideration of the provision of the plant and services 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.
5. The Appendices listed in the attached List of Appendices shall be deemed to form an integral part of this Contract Agreement. Reference in the Contract to any Appendix shall mean the Appendices attached hereto, and the Contract shall be read and construed accordingly.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Bangladesh on the day, month and year first written above.

For the Procuring Entity

For the Contractor

Signature

Name

National ID No.
Title

In the presence of Name

Address

Bank Guarantee for Performance Security (Form PG5A-11)

[This is the format for the Performance Security to be issued by any scheduled Bank of Bangladesh, without alteration, in accordance with ITT Clause 66]

Contract No: [insert reference number]

Date: [insert date]

To:

[insert Name and address of Procuring Entity]

PERFORMANCE GUARANTEE No: [insert number]

We have been informed that *[name of Contractor]* (hereinafter called “the Contractor”) has undertaken, pursuant to Contract No *[insert reference number of Contract]* dated *[insert date of Contract]* (hereinafter called “the Contract”), the execution of Goods *[description of Goods]* under the Contract.

Furthermore, we understand that, according to your conditions, the Contract must be supported by a Bank Guarantee for Performance Security.

At the request of the Contractor, we *[name of Bank]* hereby irrevocably unconditionally undertake to pay you, without cavil or argument, any sum or sums not exceeding in total an amount of Tk *[insert amount in figures and in words]* upon receipt by us of your first written demand accompanied by a written statement that the Contractor is in breach of its obligation(s) under the Contract conditions, without you needing to prove or show grounds or reasons for your demand of the sum specified therein.

This guarantee is valid until *[date of validity of guarantee]*, consequently, we must receive at the above-mentioned office any demand for payment under this guarantee on or before that date.

Signature

Signature

Bank Guarantee for Advance Payment (Form PG5A-12)

[This is the format for the Advance Payment Guarantee to be issued by any scheduled Bank of Bangladesh, without alteration, in accordance with GCC Clause 61.1]

Contract No: [insert reference number]

Date: [insert date]

To:

[insert Name and address of the Procuring Entity]

ADVANCE PAYMENT GUARANTEE No: [insert number]

We have been informed that *[name of Contractor]* (hereinafter called “the Contractor”) has undertaken, pursuant to Contract No *[insert reference number of Contract]* dated *[insert date of Contract]* (hereinafter called “the Contract”), the execution of Goods *[description of Goods]* under the Contract.

Furthermore, we understand that, according to your Conditions of Contract under GCC Clause 61.1, the Advance Payment on Contract must be supported by a Bank Guarantee.

At the request of the Contractor, we *[insert name of Bank]* hereby irrevocably unconditionally undertake to pay you, without cavil or argument, any sum or sums not exceeding in total an amount of Tk *[insert amount in figures and in words]* upon receipt by us of your first written demand accompanied by a written statement that the Contractor is in breach of its obligation(s) under the Contract conditions, without you needing to prove or show grounds or reasons for your demand of the sum specified therein.

We further agree that no change, addition or other modification of the terms of the Contract to be performed, or of any of the Contract documents which may be made between the Procuring Entity and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee is valid until *[insert date of validity of guarantee]*, consequently, we must receive at the above-mentioned office any demand for payment under this guarantee on or before that date.

Signature

Signature

Bank Guarantee for Retention Money Security (Form PG5A-13)

[This is the format for the Retention Money Guarantee to be issued by any scheduled Bank of Bangladesh in accordance with GCC Clause 64]

Demand Guarantee

[Bank's Name, and Address of Issuing Branch or Office]

Beneficiary: [insert Name and Address of the Procuring Entity]

Date: [insert date]

RETENTION MONEY GUARANTEE No.: [insert number]

We have been informed that [insert name of Contractor] (hereinafter called "the Contractor") has entered into Contract Number [insert reference number of the Contract] dated [insert date] with you, for the execution of [insert name of Contract and brief description of Works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment, payment of Tk. [insert the amount of the second half of the Retention Money] which becomes due after the Defects Liability Period has passed and certified in the form of Defects Correction Certificate, is to be made against a Retention Money Guarantee.

At the request of the Contractor, we [insert name of Bank] hereby irrevocably unconditionally undertake to pay you any sum or sums not exceeding in total an amount of Tk. [insert amount in figures] (Taka [insert amount in words]) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor failed to properly correct the defects duly notified in respect of the Supply and Installation of Plant & Equipment.

It is a condition for any claim and payment under this guarantee to be made that the payment of the second half of the Retention Money referred to above must have been received by the Contractor on its account number [insert A/C no] at [name and address of Bank].

This guarantee is valid until [insert the date of validity of Guarantee that being twenty-eight (28) days beyond the Defects Liability Period]. Consequently, we must receive at the above-mentioned office any demand for payment under this guarantee on or before that date.

Contract Amendment (Form PG5A-14)

[Insert Full Contact Details of the Procuring Entity]

CONTRACT AMENDMENT

Contract No.	
Amendment No.	
Approval Reference No.	

Contract No. [insert number/year] by and between the [insert Procuring Entity's name] and [insert Contractor's legal title] for the contract named [insert name of the Goods] is amended as follows:

1. GCC Clause [insert clause no], is hereby revised as _____

2. GCC Clause [insert clause no], is hereby revised as _____

and so on.

The effective date of this Amendment is [insert effective date] or upon execution whichever is later.

**ALL OTHER TERMS AND CONDITIONS OF THE ORIGINAL CONTRACT SHALL REMAIN IN FULL
FORCE AND EFFECT**

THIS AMENDMENT, consisting of [insert number] page(s) and [insert number] attachment(s), is executed by the persons signing below who warrant that they have the authority to execute this Amendment under the original Contract.

IN WITNESS WHEREOF, the Procuring Entity and the Contractor have signed this Amendment.

[Contractor's Authorized Signatory]

[Procuring Entity's Authorized Signatory]

Signature

Signature

Title

Date

Title

Date

Section 6. Procuring Entity's Requirements

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6.1 Scope of Supply of Plant and Installation Services by the Contractor

1.0 PROCURING ENTITY'S REQUIREMENTS

The works in this bidding document covers the design, supply, construction, installation and commissioning of new 33/11 kV, 2x20/28 MVA, Palashbari indoor sub-station by renovating existing 40 MVA outdoor substation at Savar, Dhaka, Bangladesh, under the jurisdiction of the BREB/PBS, on a design, supply, and installation basis. A list of the sites is given in Table 01 below and site plans are provided in “Drawings” section of this document.

The scope of work includes design, manufacture, quality assurance, inspection & testing, packing for export, insurance & shipment to site, civil works, complete construction & installation jointing, terminating, bonding, earthing, painting, setting to work, site testing & commissioning all the equipment necessary for operation of the sub-station.

The detail requirements are listed in the technical particulars and guaranteed schedules in the technical specification. The Contractor shall remedy all defects during the defect notification period of the equipment as per the contract.

The scope also includes imparting technical training for BREB/PBS Personnel on operation, maintenance, protection & control of 33/11 kV substations.

The Contractor shall be responsible for providing equipment, which shall meet in all respects the performance specifications and will have satisfactory durability for the prevailing site conditions. The Contractor is responsible for ensuring that all and any items of work (materials and labor) required for the safe efficient and satisfactory completion and functioning of the works in accordance with the specification, are included in the bid price whether they be individually described in the specification or not.

The site plans are included in the drawings and the locations are identified by pegs in the ground. Each bidder shall visit each site during the bidding period. Contact details of the relevant BERB/PBS representatives are given in Attachment 1. At least 10 days' notice will be required.

The Bidders shall inspect each new site to identify the location, orientation, actual space available, extent of earth works involved, construction of control building and its ancillary facilities and sub-soil investigation and soil testing reports available (which will be supplied from PMU office) including recommendations, to determine the actual scope of work. Modifications to the lay-out provided in the drawing, may be necessary based on the Contractor's detailed design and the actual available size of the land at the site.

The detailed design arrangement of the equipment shall be the responsibility of the Contractor subject to the approval of the concern committee of BREB with the recommendation of Project Manager. The Contractor shall submit all drawings, manuals, designs and calculations for review prior to commencing manufacturing and/or installation works. Typical existing BERB designs are included in Drawings section of this document, for information only.

Transportation requirements, storage, suitable construction tools, necessary equipment and all required materials for installation and connections as well as testing and commissioning are included in the scope of work.

1.1 New 33/11kV Substation– Electrical

The key requirements for the works are presented hereunder; any other works required but not included below but required to complete the substation and put it into operation is to be treated as forming a part of this contract.

1.1.1 The new 33/11kV Substation shall have the following features:

The 33 kV equipments will be out door. There will be 5 (Five) number of 33 kV feeders. The main equipment at the substation will consist of:

- ☐ 33 kV isolator and earth switch, 1250 for each feeder bay;
- ☐ 33/11kV 20/28 MVA Power Transformer, 33 kV and 11kV surge arresters, 33/0.415 kV 100 kVA Auxiliary transformer;
- ☐ 33 kV CT's and PT's for metering, indication and protection;
- ☐ 33kV OVCB and CRP for protection and control;
- ☐ 33 kV panels with mimic diagram embedded operating switches;
- ☐ 11 kV indoor switchgear panels with CT & PT;
- ☐ Substation Automation System;
- ☐ Laminated substation Single line diagrams (A0 size) on durable paper- 5 copies;
- ☐ Station supply AC panel;
- ☐ DC panel;
- ☐ Control building, outdoor yard lighting, and all indoor and outdoor electrical facilities
- ☐ Battery and charger, battery panel;
- ☐ Demo SAS.
- ☐ All relevant civil works, foundations, earth grid and structural works as detailed in this specification and shown on the drawings.
- ☐ The main earth grid including bonding of bays and all steel work / gantries shall be installed for the final configuration;
- ☐ 5 sets of As built drawing to be prepared and submitted to the following offices
 - Office of the Superintending Engineer (Grid & Substation)-1 copy
 - Dhaka PBS-1- 2- copies (1 copy to be kept in the substation and 1 copy to be kept in PBS)
 - Related SPD Office-1 copy
 - Related Xen (SOD) Office-1 copy

The quantities of each item will be as indicated in the bill of quantities and the drawings.

The conceptual single line diagrams, plans and elevations are provided in Section 7 – Drawings.

1.1.3 Terminal Points

Incoming 33kV Line

The landing span from the 33kV incoming line to the equipment is the responsibility of the line contractor and therefore the droppers from the landing pole to the substation equipment gantry shall be provided by the line contractor. If the substation equipment gantry is not ready at the time of the installation of the 33kV line this line span shall be left coiled for later connection by the substation contractor as directed by the Project Manager.

Cables within sub-station

Multi-core cabling between equipment within the substation i.e. LVAC, DC, etc. shall be provided and installed by the contractor as required under this Contract.

1.1.4 New 33/11kV Substation– Civil works

The Contractor shall be responsible for the construction of the control building and its facilities, boundary wall/ fence, fire wall and earthworks associated with each new substation. This shall include but not be limited to the following:

- ☐ Site topographical surveys and sub-soil investigations report including recommendation ☐ Testing of water and materials used in construction works
- ☐ Earthworks, and landscaping as per approved drawings
- ☐ Any required piling work. Preliminary soil test reports will be provided by the Employer, However final soil test reports and designs will be contractor's responsibility
- ☐ Temporary and permanent access roads to the substation from public roads, and service roads inside the Substations.
- ☐ A single Two storied control room building (**approx. 2×180+20 sq. meters**) having 2 storied foundations along with the facilities to electricity, water supply, sewerage, etc. as per requirements of the employer.
- ☐ Cable trenches, ducts and sump pits.
- ☐ Structure and foundations for line landing gantries, plant and equipment.
- ☐ Roads and footpaths as per design and site requirements.
- ☐ Waste water and surface water drainage systems and septic tank and soak well
- ☐ Building Services; ventilation, plumbing works, water supply, small power and lighting, telephones, fire detection, etc.
- ☐ Outdoor lighting
- ☐ Water tank as per specific site requirements.
- ☐ Any required temporary works.
- ☐ Master plan/site layout plan as per respective site condition.
- ☐ Architectural plan, section, all side elevation and also 3-D perspective.
- ☐ Structural design as per present code of practices in Bangladesh (BNBC), drawings and all documents necessary for, completion and maintenance of the works. Preparation of As-built documentation.

- ☐ Tube well and water pump to feed water tank.
- ☐ All required lighting systems.
- ☐ All required fire extinguishers.
- ☐ Any other works required but not included in the above to complete the substation and put it into operation.

TURNKEY CONTRACT FOR UPGRADATION, DESIGN, SUPPLY, CONSTRUCTION, INSTALLATION, TESTING & COMMISSIONING OF 33/11KV, 1X10/14 MVA DHAKA-2 (PALASHBARI) INDOOR SUB-STATION WORKS FOR DHAKA PBS-1.

Package No: SE(G&SS)-33/11KV-SS-Palashbari-Dhaka PBS-1

Schedule No.1: Plant and Mandatory Spare Parts

Sl No.	Description	Unit	Qty
1	Supply of Hot dip galvanized steel structure Gantry (10 nos. 10 meter tower, 21 nos. beams, 2 nos LAPI, 5 nos. VCB, 5 nos CT, 2 nos EM Tower steel structure) with all necessary accessories for installation of equipment as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Lot	1
2	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Incoming feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2
3	Supply of Control Relay Panel for 33KV Incoming feeder having Directional relay, instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT and Energy meters (accuracy-0.2s) 3 nos digital ammeter, 1 nos digital Voltmeter, 1 nos MFM as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2
4	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Outgoing feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	1
5	Supply of Control Relay Panel for 33KV Outgoing feeder having instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT and Energy meters (accuracy-0.2s) three nos digital ammeter, 1 nos digital Voltmeter, 1 nos MFM as per approved design & drawing and instruction of Engineer-in-charge.	Nos	1
6	Supply of 33KV, OVCB (1250A, 31.5 kA, 3s) for Transformer -Incoming feeder having interrupter unit including anti-pumping features with all necessary structures including tripping coil, closing coil as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2
7	Supply of 33KV Control Relay Panel for Transformer -Incoming feeder having instantaneous Overcurrent relay, Overcurrent relay IDMT, Earth fault relay IDMT, Differential Relay and Energy meters (accuracy-0.2s) three nos digital ammeter, digital Voltmeter, digital Wattmeter, digital VAR meter, digital Power Factor meter, digital Watthour meter as per approved design & drawing and instruction of Engineer-in-charge.	Nos	2
8	Supply of 33/11 KV, 20/28 MVA, OLTC Power Transformer with RTCC Control Panel and all necessary accessories including 33 & 11 KV Surge arrester as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2
9	Supply of 33KV, Single Phase Lightning Arrester (Zno Type) as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Nos.	12
10	Supply of 33KV, Isolator (1250A 31.5 kA, 3s) without Earth Blade for Incoming feeders at Bus side as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	3
11	Supply of 33KV Isolator (1250A 31.5 kA, 3s) with Earth Blade for Incoming feeders at load side as per approved design & drawing and instruction of engineer-in-charge / Employer.	Sets	3
12	Supply of 33KV, Isolator (1250A 31.5 kA, 3s) without Earth Blade for outgoing feeders at Bus side as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2

Sl No.	Description	Unit	Qty
13	Supply of 33KV, Isolator (2500A 31.5 kA, 3s Twin martin) without Earth Blade for Bus-Section as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1
14	Supply of 33kV Single Phase Current Transformer for incoming feeder where core-1 (1600-800:5A, 0.2S, 30VA) is for indicating meters on control and relay panel, core-2 (1600-800:5A, 0.2S, 30VA) is for energy meters and Core-3 (1600-800:5A, 5P20, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos.	6
15	Supply of 33kV Single Phase Current Transformer for transformer feeder where core-1 (800-400:5A, 0.2S, 30VA) is for indicating meters and energy meters on control and relay panel and core-2 & 3 (800-400:5-5A, 0.2S, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos.	6
16	Supply of 33kV Single Phase Current Transformer for outgoing feeder where core-1 (800-400:5A, 0.2S, 30VA) is for indicating meters on control and relay panel, core-2 (800-400:5A, 0.2S, 30VA) is for energy meters and Core-3 (800-400:5A, 5P20, 30VA) is for protection as per approved design & drawing and instruction of Engineer-in-charge.	Nos	3
17	Supply of 33KV, Single Phase Voltage Transformer PT 33000/ $\sqrt{3}$:110/ $\sqrt{3}$:110/ $\sqrt{3}$, Secondary winding for core-1 accuracy class-0.2, burden 50 VA dedicated for metering and for core-2 accuracy class-3P, burden 50 VA as per approved design & drawing and instructions Engineer-in-charge /Employer.	Nos.	12
18	Supply of 11KV indoor Switchgear VCB (2000 Amps, 31.5kA, 3s) for 11KV Incoming-Feeder with inbuilt CT (2000-1000:5-5-5A) where Core-1 (CL-0.2, 20VA) dedicated for Metering, Core- 2&3 (20VA, CL-5P20) dedicated for protection including Digital Master Relay, Trip relay, Directional relay, 2 nos Trip circuit supervision Relay, Energy meter (Accuracy-0.2s) with Export and Import and 03 Nos digital Ammeter, 1 nos volt meter, 1 nos MFM etc. with in-built 11 KV 2500 Amps copper bus-bar where closing and tripping coil must be operated by 110 Volt DC . in control room building inbuilt 11KV PT (11000/ $\sqrt{3}$:110/ $\sqrt{3}$:110/ $\sqrt{3}$) as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	2
19	Supply of 11KV indoor Switchgear, VCB (2000 Amps, 31.5kA, 3s) for 11KV Bus-Coupler including Bus riser with inbuilt CT (2000-1000:5-5A) where Core-1 (CL-0.2, 20VA) dedicated for Metering panel & core-2 (20VA, 5P20) dedicated for protection including digital meter relay, trip relay, 2 nos trip ckt supervision relay and 3 nos digital ammeter 1 nos volt meter, 1 nos MFM etc. with inbuilt 11KV 2500A copper Bus bar where closing and tripping coil must be operated by 110 Volt DC as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	1
20	Supply of 11KV indoor Switchgear/ VCB (630 Amps, 31.5kA,3s) for 11KV Outgoing Feeder with inbuilt CT (600-300:5-5A) in control room building where Core-1(CL-0.2, 20VA) dedicated for Metering panel & core-2(20VA, 5P20) dedicated for protection including digital meter relay, trip relay, 2 nos trip ckt supervision relay, energy meter (Accuracy-0.2s) with export & import and 3 nos digital ammeter, 1 nos volt meter, 1 nos MFM etc. with inbuilt 11KV 2500A copper Bus bar where closing and tripping coil must be operated by 110 Volt DC as per approved design & drawing and instructions Engineer-in-charge /Employer.	Sets	10
21	Supply of 11KV indoor Bus PT (11000/ $\sqrt{3}$:110/ $\sqrt{3}$:110/ $\sqrt{3}$) inbuilt with switchgear in control room building.as per approved design & drawing and instruction of Engineer-in-charge /Employer. (1 set= 3 nos)	Sets	2
22	Supply of 11KV, Single Phase Lightning Arrestor (Zno Type) as per approved design & drawing and instruction of Engineer-in-charge/Employer.	Nos	30
23	Supply of Battery (250Ah, 110V DC) and 02 Nos Battery Charger (minimum 70A) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Sets	1
24	Supply of 33/0.415KV Auxiliary 100KVA Transformer as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	2

Sl No.	Description	Unit	Qty
25	Supply of 33KV Drop out Fuse Isolator for 33/0.415KV 100KVA Auxiliary Transformer as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1
26	Supply of AC Distribution Panel as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1
27	Supply of DC Distribution Panel as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos	1
28	Supply of Miscellaneous equipment including multicore armour control cables required for works, earthing materials, 33 kV Bus-bar (4 new Span, 2500A) including loop conductor & Connector, Insulator & other related required fittings, LV cables, MK Box, sub-station lighting etc as per approved design & drawing and instruction of Engineer-in-charge.	Lot	1
29	Supply of Furniture for Control Room, Office Room,Complain Center, Rest room (1 nos. executive table, 1 nos. executive chair, 6 nos. visiting chair, 1 nos. file cabinate, 1 nos. file rake, 1 set (5 seated sofa), 1 set computer table & chair. as required) as per approved design & drawing and instruction of Engineer-in charge /Employer.	Lot	1
30	Supply of Air Conditioning System (each 2.5 Ton) for Control Room including all accessories/ components required for fitting & fixing up to commissioning as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Nos.	5
31	Supply of Desktop Computer including all accessories/components (Monitor, CPU, Printer, UPS and etc.) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Set	1
32	Supply of Laptop Computer including all accessories/ components as per instruction of Engineer-in-charge /Employer.	Nos.	1
33	Supply of submersible water Pump Motor Set with 4 inch dia suction, 2000 liter water tank including all accessories/ components required for fitting & fixing up to Commissioning (complete in all respect for drinkable water) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Set	1
34	Supply of Fire Detection & Protection Facilities for control room building including all accessories/ components required for fitting & fixing up to Commissioning as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1
35	Supply of Substation Automation System as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1
36	Supply of Demo SAS (Substation Automation System) as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Lot	1

Schedule No. 2- Installation and Other Services

Sl No.	Description	Unit	Qty
1	Testing & Commissioning.	Lot	1
2	All installation including installation of substation earthing and lighting (as required), all electrical equipments (VCB, CRP, CT/PT, Power Transformer, Isolator, LA, Battery, Battery Charger etc.) steel structure, cable laying, cable termination and other as required.	Lot	1
3	Dismantling of existing outdoor substation unit and return the materials to PBS Store as per instruction of Engineer-in-charge/ Employer	Lot	1
4	Site Development/Improvement by carted earth or sand, sandy silt (free from any organic, foreign, environmental hazardous substances) carried by head or truck or any other means in/c cost of cutting or by dredging of sand, sandy silt, all; in/c local carrying, placing the earth/sand, sandy silt in the designated area, maintaining slopes, breaking lumps, levelling and dressing in layers up to finished level etc. With Mechanical compaction of earth beyond plinth area, required for per-approved specific engineering purpose in 150 mm layers including leveling, watering and consolidation each layer.	Cum	1000
5	Supply materials and construction of Two (02) storied Control Room (10m*18m) Building (Three Storied Foundation) including guard house as per approved design & drawing and direction of Engineer-in-charge.	sq.m	380
6	Supply materials and Construction of Foundation of all Equipments and gantry Structure as per approved design & drawing and direction of Engineer-in-charge.	Lot	1
7	Surface Finishing with gravels for new Switchyard area as per approved design & drawing and direction of Engineer-in-charge.	sq.m	220
8	Supply materials and construction of approach & internal road as per approved design and drawing and direction of the engineer in charge	sq.m	120
9	Supply materials and construction of surface drain as per approved design and drawing and direction of the Engineer in charge.	Rm	106
10	Supply materials and construction of Fencing as per approved design and drawing and direction of the Engineer in charge.	Rm	150
11	Supply materials and construction of RCC Cable Trench for power cable laying as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Rm	60
12	Supply materials and construction of RCC Cable Trench for control Cable laying as per approved design & drawing and instruction of Engineer-in-charge /Employer.	Rm	80

6.2 Technical Specification

The Plant & Equipment's of 33/11kV Substation works in Palashbari Substation at Dhaka District of Turn-key works shall comply with following Technical Specifications:

SPECIFICATION

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A. ELECTRICAL

1.0 GENERAL TECHNICAL REQUIREMENTS FOR SUBSTATION ELECTRICAL EQUIPMENT

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1.0 General Technical Requirement - Electrical

1.1 Introduction

This section describes the General Technical Requirements for the design, supply, construction, installation, testing & commissioning of 33/11 kV substation works at Palashbari substation and shall be read in conjunction with the project requirements, schedules and drawings in the specification.

The Contractor shall demonstrate that the equipment has been designed, built and installed in accordance with the relevant international standards and the specification. It shall also operate and perform on a site in accordance with the requirements of the specification and in the environment defined herein.

The design shall be proven by the submission of test certificates at the time of bidding, in accordance with the relevant standards, covering all specified tests deemed to be pertinent to the plant and to the conditions in which it will operate or, if such test certificates cannot be supplied or are deemed unacceptable by the Project Manager, type tests which will be subject to the conditions of this Contract shall be carried out at no extra cost to the Employer.

Type test certificates shall be from an internationally accredited independent testing laboratory such as KEMA- Netherlands; CESI- Italy; Underwriters Laboratory (UL)-USA or CPRI-India. Proof of accreditation shall be provided with the certificate for any other laboratory.

The requirement for switchgear spares, tools and appliances, including test, maintenance and handling equipment shall be as stated in the bidding document. All devices necessary for operation and earthing shall be provided within the contract price.

1.2 System Parameters

Electrical Network Parameters:

Parameter	Network		
	33 kV	11 kV	0.4 kV Aux.
Nominal Voltage	33 kV	11 kV	0.4/0.23 kV
Rated System Voltage	33 kV	11.55 kV	0.415/0.240
Highest System Voltage	36 kV	13.2 kV	0.440 kV
Number of Phases	3	3phase 4 wire with PME system	3 ph,4 wire
Frequency	50Hz	50Hz	50 Hz
Neutral Point	Effective Earthing	Solid Earthing	Solid Earthing
3 Phase Short Circuit Capability	31.5 kA	31.5 kA	12 kA
Duration of Short Circuit			
For power transformers	3 sec	3 sec	3 sec
For other electrical equipment	3 sec	3 sec	3 sec
Impulse Withstand Voltage			
For Substation Equipment	170 kVp	75 kVp	
For Transformer Windings	170 kVp	75 kVp	
For Neutral Point -Equipment	125 kVp	70 kVp	

For Neutral Point -Transformer	75 kVp	28 kV	2 kV
Power Freq. Withstand Voltage	75 kV	28 kV	
For Substation Equipment	70 kV	28 kV	
For Transformer Windings	50 kV	28 kV	
For Neutral Point -Equipment	70 kV	28 kV	
For Neutral Point -Transformer			
Min creepage distance (mm/kV) for highest rated voltage			
Indoor exposed insulators	20 mm	20 mm	
Outdoor exposed insulators	25 mm	25 mm	
Minimum clearance in air	In accordance with IEC 60071		
Minimum clearance between walkway and the lowest live point	2750 mm	2590 mm	
Minimum safety clearance between ground and the lowest point not at earth potential of any insulator	2500 mm (Outdoor)	2500 mm (Outdoor)	
Minimum clearance between live parts and earth	381 mm	200 mm	
Minimum clearance between live fixed metal of different phases	432 mm	250 mm	
Minimum total air gap between terminal of same pole of disconnectors	432 mm	250 mm	

Electrical Station Services

A.C.	Nominally 415 V $\pm$ 10%, 4 wire system. Refer 1.2.1 below.
D.C. (Control & Protection)	110 Volt nominal tolerance on rated voltage + 10% to -15%
Main station service transformers	33,000/415 Volts $\pm$ 10% /Y aux complete with 415 Volt fused isolating switch.

1.2.1 Design of Low Voltage AC System

The design of the LV AC power and control system within the substation shall take into account the possible variations in the incoming 33 kV voltage. The auxiliary supply transformer is connected to the incoming 33 kV voltage to ensure that an auxiliary supply is available even when the power transformer is off line. However this means that the LV AC system is subject to the possible variation of the incoming 33 kV voltage. This voltage may vary from 24 kV up to a maximum of 36 kV.

The LV AC system in the substation, including the off load tapping range of the 33,000/415 V auxiliary transformer, the operating voltages of motors and contactors as well as any AC control systems shall be designed to cater for the above variation.

1.3 Climatic Conditions

Instructions to Bidders: The information in this clause is given solely for the general assistance of bidders and no responsibility for it will be accepted nor will any claims based on this clause be considered.

All plant and equipment supplied under the Contract shall be entirely suitable for the climatic

conditions prevailing at site. Atmospheric pollution is mid-level and special insulator design or washing is not required. The area is subject to high winds of typhoon strength.

Topographical and Meteorological Site Conditions

Site Location		Various locations in Dhaka Division.
Max design Altitude for all equipment operating characteristics as per IEC above sea level	m	1000
Air Temperatures		
- Maximum Peak(Design maximum ambient temperature)	°C	45
- Maximum daily average	°C	35
- Maximum yearly average	°C	30
- Minimum	°C	4
Sun temperature in direct sunlight	°C	
Maximum ground temp at depth of 1000mm	°C	30
Humidity		
Maximum relative humidity at 40degrees	%	100
Minimum relative humidity	%	50
Yearly average	%	80
Pollution level Outdoor Indoor		Medium Medium
Dust Storms	days/annum	30
Average number of days per year of thunder storms		80
Maximum wind velocity (for design purposes)	m/sec	200 km/hr (3 sec gust)
Minimum wind velocity for line rating purposes(33kV)		1.6 km/hr
Solar radiation		100 mW/sq. cm
Ice loading, radial thicknessmm		N/A
Total rainfall		1.5 m/Annum
Seismic factor (The area is designated a zone of moderate intensity for earthquakes.)		1.5 g
Soil Type		alluvial
Soil temperature (at 1.1m)	°C	30
Soil thermal resistivity		1.5°C m/w

1.4 Management Systems

1.4.1 General

The Contractor shall carry out the Works in accordance with sound quality and environmental management principles, and in particular shall have management systems which conform to the requirements of the ISO 9000 family of standards for Quality Management and the ISO 14000 family of standards for Environmental Management.

These quality management requirements shall apply to all activities including design, procurement, manufacturing, inspection, testing, packing, shipping, storage, site erection and commissioning.

The Contractor, major sub-contractors and suppliers shall have Quality Systems certified as complying with the requirements of ISO 9001 applicable to sales, design, construction and commissioning of high- and medium-voltage substations. If minor sub-contractors and suppliers do not have such systems then the Contractor's Quality System shall be deemed to apply.

It is preferred that the Bidder be certified as complying with ISO 14001 but this is not a qualifying requirement.

Documents submitted by the Bidder, including those provided by sub-contractors, will not be accepted unless they include evidence that they have been verified by the Bidder.

1.4.2 Quality Documentation and Audit

The Contractor shall submit a copy of its Quality Manual and relevant quality procedures, in the English language, within one (1) month of the Effective Date of the Contract. Quality Manuals from sub-contractor and suppliers shall be submitted within two (2) weeks of the Contractor making a commitment to them.

The Contractor shall clearly identify all quality records that will be used for the Contract.

The Employer may undertake an inspection or quality audit of the Contractor's or sub-contractor's facilities at any time. Full quality records of procurement and manufacture shall be made available at the start of factory inspection and testing of equipment. Full quality records to the completion of installation shall be made available before the start of site testing.

1.4.3 Quality Plan

The Contractor shall ensure that its quality procedures address all requirements of the Specification. The Contractor shall ensure that the quality procedures of sub-contractor, manufacturers and suppliers address all requirements of the Specification, and that the Contractor's quality procedures provide verification of this.

The Contractor shall prepare an overall Quality Plan for the Works, and shall provide detailed quality plans for all major sub-contractors and suppliers. Quality plans shall include:

Organization chart with identification and details of key personnel;

Inspection and Test Plans on which hold points and recommended inspections by the Employer are clearly shown.

Quality Plans shall be subject to the approval of the Employer. An initial Quality Plan shall be submitted with one (1) month of the Effective Date of the Contract. A revised Quality Plan which includes full details of all Inspection and Test Plans shall be submitted within two (2) months of the Effective Date of the Contract.

Not less than two (2) months prior to mobilization to Site, the Contractor shall submit the Quality Plan revised to include a complete list of all site personnel detailing names, positions and responsibilities complete with an organization chart. The Contractor shall provide for approval full details, including curriculum vitae, of all engineering, technical and other key staff to be employed at site. Personnel shall not mobilize to Site prior to approval being given.

1.4.4 Measuring and Testing Equipment

All measuring and testing equipment shall have current calibration certification. Use of measuring and test equipment which is demonstrated to be calibrated against equipment which has such certification may be accepted.

1.4.5 Inspection and Test Records

The Contractor shall compile the reports of all factory and site tests into a volume of the Operation and Maintenance Manuals.

1.4.6 Equipment Identification and Preservation

The Contractor shall establish and maintain a system for the identification, preservation, segregation and handling of all equipment from receipt through manufacturing, dispatch, storage and installation to prevent abuse, misuse, damage, or deterioration by corrosion through exposure to air or moisture.

1.5 Standards

In the technical specification references have been made to various clauses of IEC; BS; ISO and ASTM and ANSI standards. Where any standard referred to in this specification has been superseded by a new standard the reference shall be deemed to be to such superseding standards. Notwithstanding the standard numbers mentioned in the technical specification the bidders are directed to apply the latest published editions of these standards.

Deviations from the specified standards referred to above shall be given in a Schedule of Proposed Standards and shall have to be accepted by the Employer before contract placement.

1.6 Standards and Code Not Specified

Where not specified, the IEC Standard and the Bangladesh National Building Code (BNBC) shall be applicable.

1.7 Units of Measurement

In all correspondence, in all technical schedules, on all drawings and for all instrument scales, S.I. units of measurement are to be employed. Angular measurement shall be in degrees with 90 degrees forming a right angle.

1.8 Facilities and Transport to Site

Chittagong & Mongla sea ports and Benapole land port are the principal port of entry for material to Bangladesh. The contractor shall provide his own storage facilities, security, insurance etc.

The Contractor is responsible for performing all unloading, inland transportation and obtaining all approvals and consents etc. necessary for the movement of plant and Contractor's equipment from the port to the site.

All necessary access roads, jetties or off-loading points etc. required for the transport of the plant etc. to site will be the Contractors responsibility.

Where heavy loads are to be moved the Contractor shall be responsible for performing surveys of the routes to ensure that all portions have adequate load-bearing capacity.

A comprehensive method statement shall be submitted to the Project Manager detailing the proposed transport route(s) and requirements. Plans indicating all bridges, ducts, culverts, railway crossings, overhead lines, water mains etc. their load bearing capacity or clearances as appropriate shall be given together with proposed means of achieving the transportation requirements. Any reinforcement, strengthening, modifications or temporary works required to obtain the necessary capacity shall be the responsibility of the Contractor. The cost of the above is to be included in the Bid price.

No plant is to be consigned to Bangladesh by airfreight without the prior written approval of the Employer.

1.9 Documentation

1.9.1 Documentation

In order for the Employer to obtain the necessary import permits and satisfy the requirements of the customs authorities the following documentation is required.

Within 60 days of the effective date of Contract, the Contractor shall submit a detailed schedule of plant that is to be provided under the Contract indicating the type of equipment and the name of the manufacturer. Six copies of the schedule are to be submitted to the Project Manager and the Employer.

1.10 Erection and Checking at Site

As each part of the works is erected, the Contractor shall seek the Employer's approval that the works have been constructed in accordance with the specification and approved drawings.

For purposes of progress payments for site work a monthly and cumulative system of joint measurement of work done for each section of work shall be set up by the Contractor in a manner approved by the Employer.

Any works constructed prior to the issue of drawings approved by the Employer for the particular works may not be included in the percentage completion figures.

The Contractor is to provide such protection and watchmen as may be considered necessary to safeguard his materials and stores. The Employer will not accept responsibility for any loss or damage, which may occur during the execution of the Contract.

The carrying out of all the work included in the Contract shall be supervised by a sufficient number of qualified representatives of the Contractor, and full facilities and assistance shall be provided to the Employer to check the works. The Contractor shall obtain from the Employer details of the works that he proposes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if required by the Employer, shall open for inspection before erection any equipment, which has been delivered to the site partly assembled.

On completion of the works the site shall be left clean and tidy to the satisfaction of the Employer. Any damage done to buildings, structures, plant or property belonging to the Employer shall be made good at the Contractor's expense.

The Contractor shall ensure the correctness of electrical and mechanical connections to all equipment supplied under the contract before such equipment is commissioned.

During erection and commissioning the Contractor shall provide all temporary scaffolding, ladders, platforms with toe boards and hand-rails essential for proper access of workmen and inspectors, cover or rail off dangerous opening or holes in floors, and afford adequate protection against materials falling from a higher level on a person below.

The maximum personal safety must be afforded to personnel either directly engaged on this Contract or who in the normal course of their occupations find it necessary to utilize temporary works erected by the Contractor or to frequent the working area.

In each and every case involving a connection between the plant supplied under this Contract and any

other existing plant which may or may not be in service, the Contractor must make suitable arrangements as regards the time and manner in which the connection is made subject to the approval of Employer's Representative who is in charge of the existing plant. Where cases arise involving the operation of the plant or work on plant in operation or whenever required by the Employer's Representative, the Contractor must obtain a written "Permit to Work" signed by a person duly authorized by the Employer.

1.11 Contractor's Responsibilities

1.11.1 Planning of Works

Within 30 days after the effective date of Contract, the Contractor shall prepare, in an agreed form, a detailed manufacture, delivery and erection program chart for the complete Contract works, and shall submit the chart to the Employer for approval.

The manufacture, delivery and erection program chart shall indicate for each major item of the Contract the various phases of work from the commencement of the Contract to its completion, e.g., design, ordering of materials, manufacture, delivery, installation and commissioning. The program shall include a fully comprehensive drawings production program which shall demonstrate the Contractors intended issue dates for approval.

These presentations shall be in bar chart and precedence critical path analysis format.

The program shall indicate percentage completion points of the various phases which can form the basis of progress reporting.

A cash-flow forecast of the estimated monthly invoice values shall be included in the program. This forecast shall take into account the terms of payment and indicate down-payments, release of retention's, etc. Figures may be rounded to the nearest thousands of the appropriate currency.

The Contractor shall indicate in the program the number, grade and discipline of supervisory and managerial site staff proposed throughout the site construction periods. If specialist erection and commissioning staff are to be employed by the Contractor details of the number, discipline and duration of visit of these staff are to be indicated in the program. The provision of this information will not form any contractual limit on the number of staff to be provided by the Contractor to ensure the timely completion of the Contract. Should any incident occur which, in the opinion of the Contractor will result in an over-run of any section of the Works this shall be indicated in the program and brought to the Employer's attention.

If, at any time during the execution of the Contract, it is found necessary to modify the approved manufacture, delivery and erection program chart, the Contractor shall inform the Employer and submit a modified chart for his approval. The submission, and subsequent approval, of a modified manufacture, delivery and erection program chart shall not necessarily obviate or diminish the Contractor's responsibilities and liabilities under the Contract. The chart shall be updated at monthly intervals and submitted to the Employer no later than the middle of each calendar month.

1.11.2 Progress Reports and Meetings

At monthly intervals after approval of the plant manufacture, delivery and erection program chart, the Contractor shall submit to the Employer updated bar chart programs and precedence critical path analysis networks in triplicate in an approved format indicating the stage reached in the design, ordering of material, manufacture, delivery and erection of all components of plant. In addition the Contractor will compile and submit "S-curves" based upon the approved program indicating programmed and actual percentage completion of the various stages of drawing approval, manufacture, shipping, civil works and erection for each section of the works plus the overall Contract.

An updated cash-flow forecast indicating previously forecast and actual, involving levels together with revised future requirements shall be submitted quarterly. A graphical display in the form of an "S-curve" of the actual vs. planned payment certification (on & offshore) shall be provided by the Contractor in

triplicate on a quarterly basis to supplement the basic cash flow information.

If, during execution of the Contract, the Employer considers the progress position of any section of the work to be unsatisfactory, or for any other reason relating to the Contract, he will be at liberty to call meetings, either in his head office or at site. If required by the Employer, a responsible representative from the Contractor is to attend at the Contractor's expense such meetings with sufficient authority to issue instructions or effect an alteration in the works to the satisfaction of the Employer.

Access to the Contractor's and Sub-contractor's works is to be granted to the Employers representative at all reasonable times for the purpose of ascertaining progress.

1.12 Sub-contracts and Orders

As soon as practicable after entering into the Contract the Contractor may, having obtained the Project Manager's consent, enter into the sub-contracts he considers necessary, for the satisfactory completion of the Contract works. Three un-priced copies of the Contractor's sub-orders shall be supplied to the Project Manager.

One copy of any drawings where the sub-order shall refer shall also be submitted. Each sub-order and drawing shall contain the following reference and an instruction that the plant is subject to inspection and tests to be witnessed by the Project Manager or his agent with sufficient authority to issue instructions, or effect an alternation in the works to the satisfaction of the Project Manager. Approval by the Project Manager of Contractor's sub-orders shall not relieve the Contractor of his responsibilities in meeting this specification. It is the Contractor's responsibility to ensure that a full specification based on the relevant information in the Contract is passed to the sub-contractor.

The Contractor will be responsible for progressing the Sub-contractor's works including visits to the works to ensure the work as to programme, specification, quality and drawings and to witness all necessary routine, sample and type tests. The cost of this Contract control is deemed to be included in the Contract sum.

1.13 Packing and Erection Marks

Each item is to be export packed and properly protected for shipment, transport and storage in the port area and for transport to and storage on site.

All Plant provided under this Contract shall have the packing marked in the following manner.

A green band shall be painted all around each package. The band shall be 8" wide or ¼ of the length of the packing whichever is the less. Each package should have the following information printed on it in bold letters:-

- (a) Port of Loading
- (b) Name of Consignee
- (c) Purchase Order Number (d)
Brief description of Stores
- (e) Number of Package
- (f) Gross, tare and net weight
- (g) Measurements
- (h) Contractors Name
- (i) Contract Title
- (j) Contract Number
- (k) Port of Landing

All members comprising multi-part assemblies, e.g. steel frameworks, are to be marked with distinguishing numbers and/or letters corresponding to those of the approved drawings or materials lists.

Colour banding to and approved code is to be employed to identify members of similar shape or type but of differing strengths or grades.

Cases containing delicate items such as relays and instruments should carry a separate marking:

Sensitive equipment packages shall be opened in the presence of a representative of the Employer.

1.14 Contractor's Local Agent

Instruction to Bidder: The Bidder shall state in his bid the name and address in Bangladesh of his local Agent, if any.

1.15 Civil and Building Works

Where items of mechanical plant are mounted on foundations, which are part of the civil engineering works, the Contractor shall carry out suitable leveling and adjustment of the plant on the foundations, before the plant is secured in position. The Contractor shall check the alignment, leveling or positioning of the mechanical plant in question, before and after grooving. The Contractor shall make records of the alignment, leveling or positional measurement and shall maintain such records until his activities at site are concluded. The building steel work shall be designed to carry the loads/forces imposed by pipe work, cables and associated fittings which also form part of the works, and all necessary supports and fixing shall be shown on the relevant drawings.

Such supports and fixings may be secured to the steel work by bolting welding or clamping.

No other supports or fixings shall be subsequently attached to the steel work nor may any other drilling, cutting or welding be carried out without the prior permission of the Project Manager.

1.16 Design and Construction Requirements and Interchangeability

1.16.1 General Requirements

The Works shall be designed to operate safely, reliably and efficiently in accordance with the design and operating requirements stated in this specification.

No departure from the specification shall be made subsequent to the Contract without the written approval of the Employer with the recommendation of the Project Manager.

The design shall conform to the best current engineering practice. Each of the several parts of the plant shall be of the maker's standard design, provided that this design is in general accordance with the specification.

The design, dimensions and materials of all parts shall be such that they will not suffer damage as a result of stresses under the most severe service conditions. The materials used in the construction of the plant shall be of the highest quality and selected particularly to meet the duties required of them. The plant shall be designed and constructed to minimize correction. Workmanship and general finish shall be of the highest class throughout.

All plant items and corresponding parts forming similar duties shall be interchangeable in order to minimize the stock of spare parts.

All equipment shall be designed to minimize the risk of fire and damage which may be caused in the event of fire.

1.16.2 Specific Requirements

The choice of plant and design of the installation is to meet the following criteria.

Sub-station layouts are to utilize the minimum of land area.

All equipment is to facilitate the installation of all circuits indicated as "future" with the minimum of

disruption. All cabling schemes, D.C. and A.C. equipment etc. shall be designed to accommodate all such future circuits, loads, etc.

The plant and installation shall be designed for a minimum service life of 25 years.

All plant is to have a minimum of 2 years satisfactory and proven service record of high durability and reliability in a similar environment. Documentary evidence in support of the choice of any item of plant shall be provided by the Contractor if requested by the Project Manager.

Each sub-station is to be designed such that the failure or removal of any one item of plant for maintenance or repair shall not impair the operational integrity of the sub-station.

The design and layout of the sub-stations shall ensure the safety of personnel concerned with the operation and maintenance of the plant.

1.17 Plant and Equipment Identification

1.17.1 Identification on Drawings

The Contractor shall prepare comprehensive plant or equipment identification schedules. The schedules shall include the respective flow sheet or drawing/diagram identification numbers.

1.17.2 Labels and Nameplates

The Contractor shall supply and install all labels, ratings, instruction and warning plates necessary for the identification and safe operation of the works.

Nameplates of labels shall be non-hygroscopic material with engraved lettering of a contrasting color or, alternatively in the case of indoor circuit-breakers, starters, etc. of plastic material with suitably colored lettering engraved thereon.

All the above labels and plates shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self tapping screws or other approved means. The use of adhesives will not be permitted.

The language of labels, plates and notices shall comply with the requirements of the Contract.

Individual plant items and all relevant areas within the contract works where a danger to personnel exists shall be provided with plentiful, prominent and clear warning notices.

These warning notices shall draw attention to the danger or risk with words which attract attention and summarize the type of risk or danger. The notices shall also carry a large symbol which graphically depicts the type of risk.

All equipment within panels and desks shall be individually identified. The identification shall correspond to that used in schematic and wiring diagrams.

Each circuit breaker panel, electrical control panel, relay panel etc., shall have circuit designation label mounted on the front and rear. Corridor type panels shall additionally have circuit designation labels within the panels.

All equipment and apparatus mounted there on shall be clearly labeled in an approved manner. The function of each relay, control switch, indicating lamp, MCB, link etc. shall be separately labeled.

The Contractor shall be responsible for the relocation, or replacement of all labels on existing plant, which became inaccurate as a consequence of the contract works.

1.18 Safety and Security

1.18.1 Interlocks

A complete system of interlocks and safety devices shall be provided so that the following requirements and any other condition necessary for the safe and continuous operation of the plant are

provided:

- ☐ Safety of personnel engaged on operational and maintenance work on the plant.
- ☐ Correct sequence of operation of the plant during starting up and shutting down periods.
- ☐ Safety of the plant when operating under normal or emergency conditions.
- ☐ Interlocks shall be preventive, as distinct from corrective in operation.

Where plant supplied under this Contract forms the whole or a part of a system for which one of more interlocking schemes are required, the Contractor shall be responsible for all interlocking schemes for the Project Manager's approval. General descriptions of interlocking requirements are given in the specifications but the Contractor shall include for any other interlocks he considers necessary.

1.18.2 Locks, Padlocks, and Key Cabinets

The Contractor shall provide padlocks, locks, chains or other locking devices for the locking of all equipment cubicles, electrical isolating switches, selector switches, valves, etc. to the approval of the Project Manager.

All locking devices and chains shall be manufactured from corrosion resistant material. All mechanisms shall be provided with a cover to minimize entry of water or dust.

Locks shall conform to a master keying feature system to be agreed with the Project Manager for groups of equipment.

All locks shall have individual high integrity locks and shall be provided with (two) keys.

Each key shall be provided with a label as specified.

The Contractor will supply and fit key cabinets equipped with labeled hooks, each identified with its appropriate key. Every cabinet shall be provided with a nameplate identifying the cabinet with its respective item or items of plant. Sufficient cabinets will be provided to store all keys supplied under this Contract and cater for future extensions.

The Contractor shall provide comprehensive lock and key schedules to readily permit identification with equipment and doors. Such schedules are not required for loose padlocks.

Where modifications are performed to existing sites the Contractor shall provide a system identical to that existing.

1.19 Spare Parts

1.19.1 Commissioning Spares

In addition to the spare parts being provided for the Employer, the Contractor is responsible for ensuring that he has access to a stock of commissioning spares. Spares provided for the Employer are not to be utilized as commissioning spares, without written approval, in which case the Contractor shall immediately replace the contract spare at his own expense.

All commissioning spares are considered as Contractors equipment.

1.20 Consumable Items

1.20.1 Chemicals and other Consumable

The Contract includes for the provision of all chemicals, resins, and other consumables required for testing, commissioning and setting to work of each section of the works.

Unless otherwise stated, the Contractor shall provide all such chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period of 12 months for each section of the works from the date of the final certificate.

The Contractor shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.

1.21 Painting and Cleaning

Immediately following the award of a contract, the Contractor shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for a contract shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility

The painting of the plant shall be carried out in accordance with the appropriate schedule. The work is generally covered by the schedules but where particular items are not referred to specifically, they shall be treated in a manner similar to other comparable items as agreed with the Project Manager.

The schedule indicate standards of surface preparation and painting which is intended to give a minimum service life of 10 years in a coastal industrial environment, with need for minor remedial work only during the intervening period.

Steel sections and plate shall be free from surface flaws and laminations prior to blast cleaning and shall not be in worse condition than Pictorial Standard B, Swedish Standard SIS 05 5900.

The Project Manager is prepared to consider alternative paint schemes to meet the requirements of fabrication using modern automated materials handling systems, provided they offer the same standards of surface protection and service life as those intended by the schedules.

All paints shall be applied by brush or spray in accordance with the schedule, except for priming coats for steel floors, galleries and stairways where dipping is permitted.

Where paint is to be applied by spray, the applicator shall demonstrate that the spray technique employed does not produce paint films containing vacuoles.

Where paint coatings are proposed for the protection of surfaces of equipment exposed to corrosive conditions, such as plant items exposed to brines or sea water immersion in liquid, or wet gases, the coatings shall be formulated to be suitably corrosion resistant and shall be high voltage spark tested at works and/or at site prior to commissioning. The test procedure shall be based on the use of a high voltage direct current. The voltage used shall be 75% of the breakdown voltage of the coating. This breakdown voltage shall first be separately determined using test plates coated with the specified coating formulation and thickness. The coating on the test plate shall also be micro-sectioned by the applicator to show that it is free from vacuoles and other defects likely to invalidate the test procedure.

If the defects revealed by the above test procedure do not exceed one per 5 m² of coating surface, the coating need not be re-tested after the defects have been repaired. If the defects exceed one per 5 m² of coating surface, the repairs shall be resettled after any curing is completed, and this procedure shall be repeated until the defects are less than one per 5 m² of coating surface. After repair of these defects, the equipment can be placed in service without further testing.

All coating proposed for the internal protection of domestic water storage tanks and desalination plants shall be certified by an approved independent Authority as suitable for use in potable water installations and shall meet the non-painting requirements of BS 3416.

All plain shed and bright parts shall be coated with grease, oil or other approved rust preventive before dispatch and during erection and this coating shall be cleaned off and the parts polished before being handed over.

Where lapped or butted joints form part of an assembly which is assembled or part assembled prior to final painting, the jointed surfaces shall be cleaned free from all scales, loose rust, dirt and grease and given one brush applied coat of zinc phosphate primer before assembly.

Paint shall not be applied to surfaces which are superficially or structurally damp and condensation must be absent before the application of each coat.

Painting shall not be carried out under adverse weather conditions, such as low temperature (below 4⁰C) or above 90% relative humidity or during rain or fog, or when the surfaces are less than 3⁰C above dew point, except to the approval of the Project Manager or his duly appointed representative.

Priming coats of paint should not be applied until the surfaces have been inspected and preparatory work has been approved by the Project Manager or his duly appointed representative.

No consecutive coats of paint, except in the case of white, should be of the same shade. Thinners shall not be used except with the written agreement of the Project Manager.

On sheltered or unventilated horizontal surfaces on which dew may linger more protection is needed and to achieve this additional top coat of paint shall be applied.

The schedules differentiate between 'Treatment at Maker's Works' and 'Treatment at Site after Completion of Erection' but the locations at which different stages of the treatments are carried out may be modified always providing that each change is specifically agreed to by the Project Manager and the painting is finished at site to the Project Manager's satisfaction.

All paint film thickness quoted are minimum and refer to the dry film condition. All thickness shall be determined by the correct use of approved commercial paint film thickness measuring meters.

The Contractor shall ensure that precautions are taken in packing and crating to avoid damage to the protective treatment applied before shipment, during transport to the site.

Structural bolts shall be galvanized, sheradized or cadmium plated and painted as for adjacent steelwork.

All structural timber that does not require to be painted (timber joists, flooring, etc) shall be treated with two coats exterior grade approved timber preservative.

The requirements of this clause and the schedules shall be interpreted in accordance with the requirements and recommendations of BS 5493 and CP 231, 3012 and the paint manufacturer's special instructions where applicable.

Colour shall be in accordance with BS 1710 and BS 4800 or equivalent material standards.

1.22 Galvanized Work

All galvanizing shall be carried out by the hot dip process (and unless otherwise specified, shall conform in all respects with the relevant IEC specification).

Attention shall be paid to the detail of members, (in accordance with IEC specification). Adequate provision for filling venting and draining shall be made for assemblies fabricated from hollow sections. Vent holes shall be suitably plugged after galvanizing.

All surface defects in the steel, including cracks, surface laminations, laps and folds shall be removed (in accordance with IEC specification). All drilling cutting, welding, forming and final fabrications of unit members and assemblies shall be completed before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from welding slag, paint, oil, grease and similar contaminants.

The coating shall be as specified in BS 720 or equivalent National standard. Structural steel items shall initially grit blasted to BS 4232, second quality (SA2.5) and the minimum average coating weight on steel sections 5 mm thick and over shall be as specified in the table below:

THICKNESS OF STEEL AVERAGE SECTION	THICKNESS OF SIZE COATING WEIGHT	MINIMUM COATING g/m ²
mm	microns	
5	80 – 90	600
10	100 – 120	750
20	120 – 150	900

With intermediate values on a pro rata basis.

On removal from the galvanizing bath the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be jointed by high strength friction grip bolts shall be roughened before assembly so that the required slip factor (defined in BS 3294. Part BS 4606 part 1 and I) is achieved, care shall be taken to ensure that the roughening is confined to the area of the faying surface.

Bolts, nuts and washers, including general grade high strength friction grip bolts (referred to in BS 3139 and BS 4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to BS 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of a galvanized high strength friction grip bolt after the bolt has been inserted through the steelwork shall be allowed to come into contact with the faying surfaces.

During off-loading and erection, nylon slings shall be used. Galvanized work which is to be stored in works on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (with rust).

Small areas of the galvanized coating damaged in any way shall be brought to the attention of the Project Manager who shall authorize repair by:

Cleaning the area of any weld slug and through wire brushing to give a clean surface.

The application of two coats of zinc rich paint or the application of low melting point zinc alloy repair rod or powder to the damage area, which is heated to 300°C.

After fixing, bolt heads, washers and nuts shall receive two coats zinc rich paint.

1.23 Mechanical Items

All screw threads shall be of the ISO metric form and the diameters and pitch of thread for all bolts studs and nuts shall conform to the ISO Standards as stated in BS 3692 or BS 4190 or equivalent National Standard.

It is recognized that in a number of applications such as instrument, machine components and pipe, other thread forms may be used.

1.23.1 Pipe Work

All piping shall be designed, manufactured and tested in accordance with British Standards or equivalent National Standards approved by the Project Manager. In particular, pipework should meet the requirements of the following standards or their equivalents. Dimensions shall comply with Table 1 of BS 1600. The minimum wall thickness of carbon steel pipes excluding any allowance for corrosion shall be as shown in British Standards:

Diameter	Minimum Wall Thickness
0-100mm	Table 2BS1387
150-200mm	4.87mm
250-600mm	6.35mm

Drains and air vents shall be provided as required by the physical arrangement of the pipe work and shall be via valves with the drain and vent pipe work led to drain points to the approval of the Project Manager.

Screwed pipe work systems shall be provided with adequate unions to enable valves and fittings to be removed if required with minimum disturbance to the rest of the pipe system.

1.23.2 Bolts, Studs, Nuts and Washers

All bolts and nuts shall conform dimensionally to the requirements of BS 3092 or BS 4190 or equivalent National Standard.

The material of all bolts, studs and nuts for piping systems shall conform to the requirements of BS 4505 or equivalent National Standard.

The threaded portion of any bolt or stud shall not protrude more than 1.5 threads above the surface of its mating nut.

When fitted bolts are used they shall be adequately marked to ensure correct assembly.

Bolts, nuts, studs and washers in contact with sea water or used on pipe work systems containing sea water shall be of the same material as flanges etc.

The use of slotted screws shall be avoided; hexagon socket screws or recessed type heads being preferred.

1.24 Electrical Insulation

Insulating materials shall be suitably finished so as to prevent deterioration of their qualities under the specified working conditions. Account shall be taken of the IEC 60085 and IEC 60505 recommendations.

Ebonite, synthetic resin-bonded laminated material and bituminized asbestos cement-bonded panels shall be of suitable quality selected from the grades or types in the appropriate British, IEC, or approved National Standard.

All cut or machined surfaces and edges of resin-bonded laminated materials shall be cleaned and then sealed with an approved varnish as soon as possible after cutting.

Linseed oil and untreated materials of fiber, leatheroid, presspahn, asbestos or other similar hygroscopic types of materials shall not be used for insulation purposes. Untreated leatheroid and presspahn may be used for mechanical protection of winding insulation.

Wherever practicable, instrument, apparatus and machine coil windings, including wire wound resistors, with the exception of those immersed in oil or compound, shall be thoroughly dried in a vacuum or by other approved means and shall then be insulated with varnish. Varnish with a linseed oil base shall not be used.

No material of a hygroscopic nature shall be used for covering coils. Where inter-leaving between windings in coils is necessary, only the best manila paper, thoroughly dried, which permits penetration by the insulating varnish or wax, shall be used.

1.25 L.V. Circuit Protection

Fuses are not to be used for protection of circuits below 1000V phase-to-phase, (Low Voltage).

All low voltage and dc circuit protection is to be provided by moulded case, or miniature circuit breakers.

Link carriers and bases shall be of an approved manufacture and of such form and material so as to protect persons from shock and burns in normal service and maintenance. Links and fixed contacts shall be shielded to prevent inadvertent contact with live metal whilst the link is being inserted or withdrawn.

The labeling of carriers and bases shall comply with IEC 60269 Identification labels fixed to panels, boards and desks for MCBs and links shall describe their duty, voltage and rating.

1.25.1 Miniature Circuit Breakers

All miniature circuit breakers (MCBs) shall comply with IEC 60157 and be fitted with over-

current releases of both the thermal and instantaneous type. All MCBs supplied on this contract shall be to short circuit category P2 of IEC 60157.

Single, two or three pole breakers may be used where appropriate and a trip of one pole shall cause a complete trip of all associated poles. In addition the rating given of MCBs supplied shall be confirmed as that appropriate to the enclosure provided.

The Contractor shall ensure satisfactory time and current grading with other associated miniature circuit breakers or MCCBs.

1.25.2 Distribution Boards and Isolators

Distribution boards shall be provided throughout the plant for local distribution of lighting, small power and air conditioning supplies. The lighting and small power circuits may use a common distribution board.

Distribution boards shall be of 1 kV A.C., 1.2 kV D.C. rating and conform to IEC 60439. All distribution boards shall be of the weatherproof enclosure type and shall be arranged so that the door or cover can be locked in the closed position.

All triple pole and neutral boards shall provide satisfactory cable entry for all cables which could be required for the number of circuit facilities provided and shall have the neutral bar drilled for the full number single phase ways.

Each distribution board supplied from a remote location shall have a load breaking/fault making incoming isolating switch mounted adjacent to or as part of the distribution board. Each distribution board shall have removable top and bottom (undrilled) gland plates.

Each circuit in every distribution board shall be numbered and identified by means of a schedule attached to the interior of the door or cover of the board. The schedule shall be legible and durable to the Project Manager's approval.

Twenty-five percent spare ways shall be provided for future use.

1.26 Electrical Equipment, Instruments and Meters

All instruments and meters shall be fitted with glasses of low reflectivity and shall not cause pointer deflection due to electro-static charging through friction.

All indicating instruments shall be of the flush mounted pattern with dust and moisture proof cases complying with BS. 2011, Classification 00/50/04, and shall comply with BS. 89 or IEC 60051.

Unless otherwise specified, all indicating instruments shall have 95mm square cases to DIN standard or equivalent circular cases.

Instrument dials in general shall be white with black markings and should preferably be reversible where double scale instruments are specified.

Scales shall be of such material that no peeling or discoloration will take place with age under humid tropical conditions.

The movements of all instruments shall be of the dead beat type.

Instruments shall be provided with a readily accessible zero adjustments.

The mounting height of the centre of all indicating instruments shall not exceed 2000mm.

A.C. ammeters for transformer, feeder or inter connector circuits, and D.C ammeter for all load circuits except motors, shall have linear scales commencing at zero.

A.C and D.C ammeters for motor circuits shall have scales commencing at zero and with a compressed overload portion for reading of the associated minor starting current.

D.C. ammeters for the main battery circuit of D.C. systems shall have scales with positive and negative ranges, labeled charge and discharge respectively.

Voltmeters for feeders and transformer circuits shall have expanded scales to display the nominal service voltage $\pm 20\%$.

Wattmeter for feeders shall have linear positive and negative reading scales to be approved.

Varmeters for all circuits shall have linear positive and negative reading scales to be approved.

Integrating metering shall be provided where indicated on the specification drawings. These meters shall be of the withdrawable flush mounted type and comply with the relevant parts of IEC 60521 and BS 5685, Class 1.0 accuracy and BS 37, Part 9. The meters shall include cyclometer dial type registers.

Approved test terminal blocks of the three-phase type shall be provided for connecting in circuit with each meter a portable testing meter.

If applicable, recording instruments shall be of an approved type, and unless otherwise specified, shall have two chart speeds of 25 mm and 50 mm per hour available for selection by means other than changing connections. They shall be complete with sufficient charts and inks for two years' working.

All instruments, meters, recorders and apparatus shall be capable of carrying their full load currents without undue heating. They shall not be damaged by the passage of fault currents within the rating of the associated switchgear through the primaries of their corresponding instrument transformers.

All instruments, motors and apparatus shall be back connected and the metal cases shall be earthed.

All voltage circuits to instruments shall be protected by a fuse in each unearthed phase of the circuit placed as close as practicable to the main connection.

All power-factor indicators in 3-phase circuits shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the instrument current transformer secondary windings.

All instruments and meters associated with multi-ratio CT's shall be provided with sets of scales etc. appropriate to each CT ratio. It shall be possible to replace the scales of instruments without dismantling the instruments or interfering with any tropicalization finish.

The Contractor shall provide electrical instrument and meter schedules to include, manufacturer, type, designation, current and voltage rating, accuracy class and circuit designation.

All equipment shall be colored "NEMA Standard Grey 70" unless otherwise specified by the Project Manager.

1.27 Control and Selector Switches

Control switches shall be of the three-position type with a spring return action to a central position (and without a locking feature).

Circuit breakers shall have control switches which shall be labeled open/N/close or (O/N/I and arranged to operate clockwise when closing the circuit breakers and anti-clockwise when opening them, and shall be of the pistol grip type.

Control switches of the discrepancy type shall be provided where specified. Such discrepancy control switches shall be arranged in the lines of the mimic diagram on the switchgear panels. Such switches shall include lamps and be of the manually operated pattern, spring loaded such that it is necessary to push and twist the switch past its indicating position for operation. The lamp shall be incorporated in the switch base and shall flash whenever the position of the circuit breaker is at variance with the position indicated by the control switch. Hand dressing of the control switch to the correct position shall cause the lamp to extinguish.

Selector switches shall be of the two or more position type as required, and have a stay-put action to

remain in any selected position which shall be lockable (separate padlocks each with duplicate keys should be provided). Each position of the selector switches shall be suitably labeled to signify their function. The switch handle shall be of the pistol grip type to the approval of the Project Manager.

It shall not be possible at any time to operate any switchgear equipment from more than one location simultaneously, and suitable lockable selector switches shall be provided to meet this requirement.

The contacts of all control and selector switches shall be shrouded to minimize the ingress of dust and accidental contact, and shall be amply rated for voltage and current for the circuits in which they are used.

1.28 Auxiliary Switches

Auxiliary switches shall be to approval and contacts shall have a positive wiping action when closing.

All auxiliary switches, whether in service or not in the first instance, shall be wired up to a terminal board and shall be arranged in the same sequence on similar equipment.

Auxiliary switches mechanically operated by the circuit breakers, contactors, isolators, etc. shall be to approval and contacts mounted in accessible positions clear of the operating mechanism of the circuit breaker, contactor, isolator, etc., and they shall be adequately protected against accidental electrical shock.

Auxiliary switches shall be provided to interrupt the supply of current to the trip coil of each circuit breaker and contactor immediately the breaker or contactor has opened. These auxiliary switches shall make before the main contacts, during a closing operation.

A minimum of four spare auxiliary switches, two normally open, two normally closed shall be provided for each circuit breaker, and contactors and also for isolators.

1.29 Alarm Equipment

Where an alarm system is specified, it shall consist of an initiating device, a display unit and push buttons mounted on the front of the appropriate control panel, together with a continuously rated audible warning device flasher unit and relays. The relays shall wherever possible, be mounted inside the same panel; where the number of alarms to be displayed makes this impracticable, a separate alarm relay cubicle or cubicles will be considered as an alternative.

Where it is necessary to differentiate between the urgency of alarms then various approved alarm tone devices shall be provided in this Contract. In addition and where specified an alarm beacon to the approval of the Project Manager shall be provided.

The display unit shall consist of a rectangular frame or bezel enclosing the required number of individual facias, each of which shall be preferably approximately 32mm x 25mm in size. Each fascia shall be in the form of a window inscribed with the specified legend, describing the fault condition to be indicated. Lamps shall not illuminate adjacent windows.

At least 3 spare ways shall be provided on each display unit. All unused ways in a display unit shall be fully equipped and the alarm system designed to enable these ways to be utilized at a future date.

Alarm relays shall be of a type to the approval of the Project Manager, arranged to plug into fixed bases, either singly or in groups and have positive means of retaining them securely in the service position, the bases being mounted on racks or frames which shall be hinged to allow them to be swung clear of the sides of the panel or cubicle in which they are installed in order to provide ready access.

The type of wiring used for internal connections between alarm facias and their relays and between relays and terminal blocks, shall generally comply with these requirements with the following exceptions:-

- (i) Single-strand wire, not less than 0.85 mm in diameter may be used.

Soldered terminations will be acceptable

External connections for alarm circuits will in general be run in multi-core cables having a larger core size than that referred to above. This will necessitate special terminal blocks, if soldered terminations are used, in which case the internal and external terminations of each pair shall be joined by a removable link. Samples of the type of wire and terminal block to be used for alarm connections shall be submitted for the Project Manager's approval.

The operation of the alarm system shall be as follows:-

When an external alarm indicating contact closes the audible warning shall sound continuously and the appropriate facia shall be illuminated by a flashing light at a frequency which allows the inscription to be easily read.

An 'Accept' push-button shall be provided on or near the display unit, which when pressed, shall silence the audible signal and cause the facia to remain illuminated steadily.

The alarm circuit shall be designed to retain the indication after the re-opening of the initiating contact, requiring a separate 'Reset' push button to be pressed before the alarm is cancelled.

A 'Test' push button shall be fitted close to the 'Accept' and 'Reset' buttons, to illuminate all the facias on the associated display unit for as long as the 'Test' button is held depressed.

The operation of the 'Accept' button shall not preclude the receipt of further indications giving more audible alarm and visual indications as the result of the operation of other sets of alarm contacts.

Relays shall not be continuously energized when the alarm system is at rest.

For all alarm indication initiating device a spare set of voltage-free contacts shall be provided (this may be by the use of auxiliary relays) and connected by cable to a suitable, approved marshalling cubicle. These spare contacts will provide for the transmission of the alarm indication signals to the remote Grid Control Centre.

The Contractor shall be responsible for providing all the alarms required for the safe and efficient operation of the plant. General descriptions of alarms requirements are given in the specification and the Contractor shall include any other alarms that are necessary due to the type of equipment and design of the plant to the Project Manager's approval.

1.30 Panels, Desks, Kiosks and Cubicles

1.30.1 General Requirements

Unless otherwise specified, panels, desks and cubicles, shall be of floor-mounted and free-standing construction and be in accordance with the specified enclosure classification. All control and instrumentation panels shall be identical in appearance and construction.

Panels shall be rigidly constructed from folded sheet steel of adequate thickness to support the equipment mounted thereon, above a channel base frame to provide a toe recess. Alternatively a separate kicking plate shall be provided.

Overall height, excluding cable boxes, shall not exceed 2.5 m. operating handles and locking devices shall be located within the operating limits of 0.95m and 1.8m above floor level. All panels shall be fitted with padlocks. The minimum height for indicating instruments and meters shall be 1.5m unless otherwise specified.

All panels' desks and cubicles shall be vermin and insect proof. All cable entries to equipment shall be sealed against vermin as soon as possible after installation and connecting-up of the cables to the approval of the Project Manager.

Ventilation shall be provided for natural air circulation. All control equipment shall be designed to operate without forced ventilation.

For outdoor equipment, metal to metal joints shall not be permitted and all external bolts or screws shall be provided with blind taped where a through hole would permit the ingress of moisture. All metal surfaces shall be thoroughly cleaned and particular care taken during painting to ensure that both internally and externally a first class cover and finish is achieved. For harsh environments, all nuts, bolts and washers shall be plated.

Door sealing materials shall be provided suitable for the specified site conditions. Doors shall be fitted with handles and locks. The doors shall be capable of being opened from within the panel without the aid of a key after they have been locked from the outside. Hinges shall be of the life-off type. Seals shall be continuous or with only one joint.

The bottom and/or top of all panels shall be sealed by means of removable gasketed steel gland plates and all necessary glands shall be supplied and fitted within the Contract.

Panels shall be suitably designed to permit future extension wherever appropriate or specified without the need to dismantle the existing panels. Panels shall be "top entry" types with respect to control cabling.

Each panel shall include rear access doors and door-operated interior lamp, and be clearly labeled with the circuit titled at front and rear, with an additional label inside the panel. Panels sections accommodating equipment at voltages higher than 110 V shall be partitioned off and the voltage clearly labeled. Each relay and electronic card within panels shall be identified by labels permanently attached to the panel and adjacent to the equipment concerned. Where instruments are terminated in a plug and socket type connection both the plug and the socket shall have permanently attached identifying labels.

Instrument and control devices shall be easily accessible and capable of being removed from the panels for maintenance purposes.

For suites of panels inter-panel bus wiring shall be routed through apertures in the sides of panels and not via external multi-core cabling between the panels.

All panels, whether individually mounted or forming part of a suit, shall incorporate a common internal copper earthing bar onto which all panel earth connections shall be made. Suitable studs or holes to the Project Manager's approval shall be left at each end of the bar for connection to the main station earthing system.

Earth connection between adjacent panels shall be achieved by extending the bar through the panel sides and not by interconnecting external cabling.

Cubicles and cubicle doors shall be rigidly constructed such that, for example, door mounted emergency trip contacts can be set so that mal-operation will not be possible due to any vibrations or impacts as may reasonably be expected under normal working conditions.

1.30.2 Indicating Lamps

All new indicators shall have a minimum continuous burning guaranteed life of 10,000 hours, at their rated voltage.

The Indicating lamps must be LEDs only and cluster LEDs for important functions subject to approval of the Project Manager.

Indicators shall be easily replaceable from the front of the panel and shall be adequately ventilated. LED indicators shall operate at not less than 20mA and red LED indicators shall be of the high brightness types.

The lamps shall be clear and shall fit into a standard form of lamp holder. The rated lamp voltage should be ten percent in excess of the auxiliary supply voltage, whether AC or DC. Alternatively, low voltage lamps with series resistors will be acceptable, however resistors shall be dimensioned to avoid damage due to heat.

The lamp glasses shall comply with BS 1376 and BS 4099 or equivalent National Standard and shall be in standard colours, red, green, blue, white and amber. The colour shall be in the glass and not an applied coating and the different coloured glasses shall not be interchangeable. Transparent synthetic materials may be used instead of glass, provided such materials have fast colours and are completely suitable for use in tropical climates.

Normally energized indicating lamps, if employed, shall in general be energized from the station LVAC supply.

Lamps and relays incorporated in alarm facia equipment shall be arranged for normal operation from the station battery, subject to the approval of the Project Manager.

Lamp test facilities shall be provided so that all lamps on one panel can be tested simultaneously by operation of a common push-button. Where alarm facias are specified, all alarm and monitoring indications (apart from circuit-breaker and disconnecter position indications) shall be incorporated in the facia.

Where specified every circuit breaker panel shall be equipped with one red and one green indicator lamp, indicating respectively circuit closed and circuit open and an amber lamp for indicating 'auto-trip'. Where specified in the lines of mimic diagrams, indicating lamps may be of the three-lamp single-aspect type.

All lamps shall be renewable from the front of panels without the use of special tools.

The variety of indicating lamps provided shall be rationalized to reduce maintenance and spares requirements.

1.30.3 Anti-Condensation Heaters

All switchboards, panels, cubicles, motor control Centre and the like shall incorporate electric heaters capable of providing movement of sufficient heated air to avoid condensation. The power supply to the heaters shall be manually switched by a two pole switch with red lamp. All heaters on multi-panel equipment shall be controlled from a single point. The related equipment shall be designed to accept the resulting heat input.

Bus wiring shall be incorporated in switchboards for supplying the heaters.

1.31 Panel Wiring and Terminal Boards

1.31.1 General

All electrical equipment mounted in or on switchgear, panels, kiosks, and desks, etc. shall have readily accessible connections and shall be wired to terminal blocks for the reception of external cabling.

All wiring shall be of adequate cross-sectional area to carry prospective short-circuit currents without risk of damage to conductors, insulation or joints.

All cabling shall be of type CR or CK to BS 6231 unless the design of the plant requires the cabling to withstand more onerous operating conditions in which case cabling shall be suitable for these conditions. The minimum cross section of wire shall be 4 sq.mm for all secondary wiring associated with current transformers of nominal secondary rating of 0.5A or greater. The size of wiring for circuits other than CT secondary wiring shall be not less than 2.5 sq. mm. Cross-sectional area, save as permitted in the specification.

The minimum strand diameter of copper or tinned copper flexible conductors shall be 0.20 mm for flexible and the minimum cross-sectional area shall be 0.5 sq. mm for all cables. For wiring within panels on circuits not directly associated with circuit breaker protection and control, and having a continuous or intermittent, load current of less than 1 amp, the use of smaller line down to 0.25 sq. mm will be permitted subject to Project Manager's Approval.

Where an overall screen is used, this shall be metallic screen or low resistance tape, with drain wire as above.

Wiring shall be supported using an insulated system which allows easy access for fault finding and facilitates the rapid installation of additional cables.

Small wiring passing between compartments which may be separated for transport shall be taken in terminal blocks mounted near the top of each compartment, separately from those for external cable connections.

Both ends of every wire shall be fitted with ferrules of insulating material complying with BS 3858 or equivalent National Standard and engraved in black. The identification numbering system used for the ferrules shall be to the approval of the Project Manager.

Where new equipment must interface with existing equipment double ferruling shall be employed if the two numbering system are not compatible.

Connections to apparatus mounted on doors, or between points subject to relative movement, shall be made in cable type CK to BS 6231, arranged so that they are subjected to torsion rather than bending.

1.31.2 Identification of Cable Cores

Where a wire or multi-core cable passes from one piece of equipment to another, e.g. from a circuit breaker to a remote control panel, the Contractor shall ensure that the identity of the wire is apparent at both ends and intermediate marshalling points by the use of ferrules, which shall permit identification of the cable in accordance with the schematic diagrams. The ferruling system to be adopted shall be a composite marking method to IEC 391 and BS 3858 as appropriate, giving functional information on the purpose of the individual conductor plus markings at both-ends.

Should the Contractors normal practice be at variance with the requirements of this clause he may submit details of the scheme proposed for consideration by the Project Manager. The Project Manager is not obliged to accept the Contractor's proposal.

Each core of multi-pair wiring shall be identified by color and terminal block identification together with an identification tracer per bundle.

Permanent identification of all terminals, wires and terminal blocks shall be provided. Each individual terminal block shall have independent terminals for incoming and outgoing cabling.

1.31.3 Terminals and Terminal Boards

Terminal Assemblies shall be of the unit form suitable for mounting on a standard assembly rail, to give the required number of ways. The units shall be spring retained on the assembly rail. Each individual terminal block shall have independent terminals and outgoing cabling.

End barriers or shields shall be provided for open sided patterns.

It shall be possible to replace any unit in an assembly without dismantling adjacent units. Moulding shall be mechanically robust and withstand the maximum possible operating temperatures and torque which may be applied to terminal screw. All live parts shall be recessed in the moulding to prevent accidental contact.

Terminals shall be of the screw clamp type for lower current rating which compress the conductor or termination between two plates by means of a captive terminal screw. Contact pressure of screw clamp terminations shall be independent of each other. For higher current ratings bolted type terminals are permitted. Current carrying parts shall be non-ferrous and plated.

All terminals for “incoming” cabling shall have testing facilities, which permit the examination of the state of the circuit without disconnecting the associated cabling. Terminal blocks for current transformer secondary shall be fitted with shorting/disconnect facilities.

Terminal blocks for voltage transformers secondaries shall be isolatable.

Terminal blocks in telemetry marshalling cubicles shall be isolatable. The means of isolation shall be fixed and give visual identification of the status of the terminal.

Not more than 1 wire shall be connected to each terminal and cross-connection facilities shall be provided where numerous cores are to be connected together.

Each terminal block, and every individual terminal shall be identified. The terminal identification number shall be included on associated schematic and wiring diagrams.

The mounting rail may only be used to provide an earth connection, when firmly bonded to the earth bar and to be approved by the Project Manager.

The Contractor shall submit samples of the terminal blocks/mounting rail assemblies together with details of his proposed cabling/termination system to the Project Manager for approval.

Adjacent terminals to which wires of different voltage, polarity or phase are connected shall be separated by a protruding insulating barrier; this requirement also applies to terminals carrying wires of the same voltage but originating from different sources.

Wires shall be grounded on the terminal boards according to their functions. Terminal blocks for connections exceeding 110V shall be fitted with insulating covers.

Terminal blocks shall be mounted not less than 150 mm from the gland plates, and spaced not less than 100 mm apart, on the side of the enclosure.

Sufficient terminals shall be provided to permit all cores on multicore cables to be terminated. Terminals for spare cores shall be numbered and be located at such position as will provide the maximum length of spare core. At least 10% spare terminals shall be provided in all cases.

The tails of multi-core cables shall be bound and routed so that each tail may be traced without difficulty to its associated cable. All spare cores shall be made off to terminals.

When two lengths of screened cable are to be connected at a terminal block (i.e. junction box) a separate terminal shall be provided to maintain screen continuity.

Should the terminal block manufacturer recommend that specific types of terminal tools are used (eg parallel sided screw/drivers) the Contractor shall provide three sets of these at each sub-station site. In addition the Contractor shall provide 8 numbers, test leads of minimum 1500 mm length which can be inserted into the test terminals of the terminal blocks, at each sub-station. The test leads shall be capable of being ‘jumped’ together for multi-instrument use.

The use of pre-formed factory tested cable connections to field mounted marshalling boxes shall be to the Project Manager’s approval.

1.32 Cable Boxes and Glands

Electrical equipment supplied under this contract shall be fitted with all necessary cable boxes and glands which shall be complete with all required fittings. Boxes shall be of adequate proportions to accommodate all cable fittings, including stress cones or other means of cable insulation grading, and designed in such a manner that they can be opened for inspection where appropriate without disturbing the gland plate of incoming cable.

Glands for termination of cables to outdoor equipment or indoor areas liable to water spray, hosing or flooding shall incorporate provision for sealing against ingress of moisture or dust, and shall comply with the requirements of BS 6121 for sealing.

Removable gasketed steel gland plates shall be provided for multi-core cables and shall be supported from the sides of the enclosures, as near to the floor or roof as possible while allowing adequate space both above and below the plate for manipulation of the cable and gland. Gland plates for marshaling boxes shall be in the form of removable gasketed steel plate, forming part of the underside of the box.

The terminals for 3 phase cables shall be clearly marked with the phase colours (approved designations) to enable the cables to be terminated in the correct sequence.

Filling and venting plugs where required, shall be positioned so as to avoid the possibility of air being trapped internally and adequate arrangements shall be made for expansion of compound etc. There shall be no possibility of oil entering the cable box from an associated oil filled compartment. Cable sealing ends shall be arranged to project at least 25mm above the gland plate to avoid moisture collecting in the crutch.

Any chamber which is to be compound filled shall be clean and dry and at such a temperature before filling that the compound does not solidify during the filling process. Filling orifices shall be sufficiently large to permit easy and rapid filling.

All cable boxes shall be designed to withstand the high voltage D.C. cable tests prescribed in BS 6346, BS 6480 and IEC 60055 as appropriate.

If applicable, cable boxes for paper-insulated cables shall be complete with universal tapered brass glands (insulated from the box in an approved manner and including an island layer for testing purposes).

Even single core cables are used, particularly for currents in excess of 500 A, adequate steps must be taken to minimize the effects of eddy currents in the gland and bushing-mounted plate.

Cable glands for extruded solid dielectric insulated cables (PVC, EPR, and XLPE) shall be of the compression type and as specified in BS 6121.

Approved glands shall be used on MICC cables

Glands for armored or screened cables above 240 sqmm shall be provided with an integral heavy duty earthing lug capable of carrying the full earth fault current for a period not less than 1 second without deterioration.

Cable lugs and terminations for the receipt of all power control and instrumentation cable cores shall be provided.

Cable boxes for the termination of elastomeric cables up to 33 kV nominal service voltage shall be designed and dimensioned to provide adequate insulation in air for cables. Clearance and creepage distances shall be adequate to withstand the specified alternating current voltages and impulse voltages for service under the prevailing site conditions. The performance is to be met without the use of insulating 'boots' shrouds or any other material fitted over or between the cable terminations apart from permanently fitted barriers forming part of the switchgear or cable box.

Means shall be provided for preventing accumulation of dirt, dust, moisture, vermin or insects such as to maintain the anticipated life of the equipment. The Contractor shall ascertain the means by which elastomeric cables are to be terminated and shall provide such information or instructions as necessary to any other contractor or sub-contractor to ensure compliance with this clause.

The cable crutch within a cable box or equipment panel shall be protected by the use of a heat-shrink plastic 'udder' placed over the conductors and crutch.

1.33 Joints and Gaskets

All joint faces are to be flat and parallel to the approval of the Project Manager and arranged to prevent the ingress of water or leakage of oil with a minimum of gasket surface exposed to the action of oil or air.

Oil-resisting synthetic rubber gaskets are not permissible, unless the degree of compression is accurately controlled. For gaskets of cork or similar, oil resisting synthetic rubber may be used as a bonding medium. No joints are allowed in gaskets.

1.34 Junction, Termination Marshaling Boxes, Operating Cubicles etc

All junctions, termination and marshaling boxes shall be of substantial sheet steel construction, having enclosure classification in accordance with the specification and fitted with external fixing lugs and finished in accordance with this Specification for cleaning, painting and finishing.

The boxes shall allow ample room for wiring, with particular regard to the deployment of wires from the point of entry.

Outdoor boxes shall have internal anti-condensation heaters and stay bars fitted to doors. Indoor boxes shall be designed such that any condensed water cannot affect the insulation of the terminal boards or cables. No cables shall be terminated into the top of outdoor boxes unless specifically approved by the Project Manager.

Each box shall be complete with suitably inscribed identification labels.

Any outdoor boxes, cubicles etc containing instruments or meters shall have glazing suitable to permit the visual examination of these.

Covers shall be arranged for padlocking and padlocks with keys shall be supplied. Cast iron boxes shall have bolted lids requiring the use of special keys or spanners for removal.

All boxes shall be provided with adequate earthing bars and terminals.

Notwithstanding information supplied by the Project Manager, the Contractor shall, as each box is completed or at intervals as requested by the Project Manager, supply to the Project Manager copies of accurate termination or destination charts showing the as-fitted arrangement of cables and cores in each box. The Contractor shall, following the Project Manager's approval, fit one plastic laminated copy of the appropriate chart to the interior of each box.

1.35 Conduit and Accessories

Conduit, accessories and trunking installation shall comply with the latest issue of the Institution of Electrical Engineers Regulations for the Electrical Equipment of Buildings, unless otherwise approved by the Project Manager. In addition installation shall also comply with all local electricity regulations.

Unless otherwise approved, all conduit and conduit fittings shall be galvanized, of heavy gauge steel, screwed, solid drawn or weld type complying with IEC 60423 and IEC 60614.

No conduit smaller than 19 mm outside diameter shall be used.

Standard circular boxes or machined face heavy-duty steel adaptable boxes with machined heavy type lids shall be used throughout. For outdoor mounting all boxes shall be galvanized, weatherproof and fitted with external fixing lugs.

Conduit terminations shall be fitted with brass bushes.

The use of running threads, solid elbows and solid tees will not be permitted.

Conduit ends shall be carefully reamed to remove burrs. Draw-in boxes shall be provided at intervals not exceeding 10m in straight-through runs.

Conduit runs shall be in either the vertical or horizontal direction unless otherwise approved and shall be arranged to minimize accumulation of moisture. Provision for drainage shall be made at the lowest points of each run.

Conduits shall be supported on heavy galvanized spacer saddles so as to stand off at least 6 mm from the fixing surface.

Provision shall be made for the support of internal conductors in instances where the length of the vertical run exceeds 5m.

All conduits run in any circuit are to be completed before any cables are pulled in.

Flexible metallic conduit shall be used where relative movement is required between the conduit and connected apparatus, and a separate copper connection provided to maintain earth continuity.

The maximum number of cables in any conduit shall be in accordance with the latest issue of the IEE Regulations for the Electrical Equipment of Buildings.

1.36 Trunking

Steel trunking etc. may be used for running numbers of insulated cables or wires in certain positions to the approval of the Project Manager. The trunking thickness shall not be less than 1.2 mm.

1.37 Push-Buttons and Separately Mounted Push-Button Stations

Push-buttons shall be shrouded or well recessed in their housings in such a way as to minimize the risk of inadvertent operation. The colour of push-buttons shall be black unless otherwise required by the Project Manager.

Push-button stations supplied as loose equipment shall be of the metal clad weatherproof type suitable for wall or bracket mounting. Each push-button station shall be clearly labeled showing the duty or drive to which it is applicable.

1.38 Drawings, Diagrams and Calculations

1.38.1 General

The term “drawing” shall also include diagrams, schedules, performance curves, and calculations etc., required for the comprehensive design of the works. The Contractor shall be responsible for the provision of all drawings required for the various stages of the contract. All drawings, apart from workshop drawings, shall be submitted to the Project Manager for his recommendation and final approval by the concerned committee of BREB, in accordance with an approved program. The Contractor shall ensure that drawings are submitted for approval in good time such that they may be approved within the specified period prior to the manufacture or construction commencing. Further adequate time must be allowed by the Contractor to permit any comments made by the Project Manager to be incorporated. Any works performed prior to approval of drawings by the concerned committee of BREB will be entirely at the Contractor’s own risk including any delays that may result from modifications being found to be necessary by the Project Manager.

The Contractor shall be fully responsible for obtaining any drawing or data of existing plant and installations that he requires in order to carry out the works, and shall also be responsible for verifying that any drawings of existing plant and installations are accurate. The Contractor shall provide suitable drafting and other staff on site that he requires investigating and producing any drawings that he requires of existing equipment and installations in order to carry out the works. Any cost associated with these requirements is deemed to be included in the contract price.

Where existing installations have been modified or extended the Contractor shall provide

complete new sets of drawings. In this respect the Contractor shall provide drawings detailing both the existing and new works and shall not limit the scope of the drawings to the new works only.

5 (Five) sets of As-built drawings together with operation and maintenance manual of the equipment installed shall be submitted.

1.38.2 Format

Drawings are to be submitted for approval on paper prints, folded to A4 size with the project title block and drawing numbers fully visible.

All drawings are to be submitted on “A” series paper to ISO/5457. The maximum size of drawings shall be A1 except for site survey and layout drawings which may be submitted as A0 size sheets, if necessary, to accommodate details on a scale of 1:100. Single line diagrams and schematic drawings shall preferably be on a maximum sheet size of A2. All dimensional drawings shall be to the following scales and fully detailed. 1:1, 1:2, 1:5, 1:10 and factors of 10 thereof.

Drawings symbols shall be in accordance with IEC 60117.

All drawings are to be submitted in Auto Cad format in CDR Disks.

Drawing titles shall clearly identify the specific function of the drawings and where appropriate the name of the site(s) to which the drawing applies.

1.38.3 Drawing Numbering and Revisions

The Contractor shall be responsible for adding the Employer’s drawing numbers to all drawings prior to submittal. Following award of the contract, the Project Manager and the Contractor will review the numbering system, familiarize each other with requirements, and agree on the numbering system to be applied.

Comprehensive cross-references are to be included on drawings and the Contractor shall include the Employer’s drawing numbers in the cross-references.

At each and every issue of a drawing the revision shall be raised, and details given in revision boxes on the drawings. Comprehensive details of revisions are to be given and phrases such as “REVISED”, “UPDATED”, “MODIFIED” or similar are not acceptable.

Reference to any drawing in communications shall include the Employer’s drawing number.

1.39 Operating and Maintenance Manuals

1.39.1 General

The Contractor shall be responsible for compiling operation and maintenance (O&M) manuals for each section of the works and all equipments used.

Drafts of the manuals are to be submitted to the Project Manager at least six weeks prior to the commencement of pre-energization commissioning checks on Site. Following examination the Project Manager will forward copies of his comments to the Contractor to action prior to issuing Final O&M manuals. Final O&M manuals are to be available on site prior to the issue of the Taking over Certificate.

Handling, installation, storage and transit instructions, in accordance with BS 4884 part 1, which shall form part of the manuals, are to be available on site prior to the arrival of the Plant.

In addition to the compiled manuals, the Contractor shall submit copies of brochures and other explanatory literature with drawings of the plant, which will assist the Project Manager in approval of the drawings.

1.39.2 Contents

Operation and Maintenance manuals shall be prepared for the equipment supplied for the substation. The content and presentation of the manuals shall conform in full with BS 4884 parts 1 and 2.

The O&M manuals are also to contain a complete drawing list appropriate to the individual section of the works. The drawing list shall include the Project Manager's drawing numbers.

Maintenance instructions for all plant shall cover preventive and corrective maintenance procedures. For electronic or solid state control, protection equipment etc. details shall be provided to enable individual circuit cards to be checked for correct operation and faults to be traced, and repaired.

The Contractor shall provide proformas of the required maintenance record sheets for all plant, which shall include cross-reference to the appropriate section of the O&M manuals which detail how to perform the tasks required. Any other record sheets suitable for the monitoring of the plant shall also be designed and provided.

1.39.3 Binders, Presentation

The information will be provided on A4 pages, with diagrams on throw-clear pages where required to enable the text and diagrams to be refereed to simultaneously.

The front cover and spine of the manuals shall give the following information:

Project Title
Employer's name
Contract number

Identification of the Section of the Works

Volume number and total number of volumes applicable (e.g. volume 3 of 5 volumes)

Contractor's company logo and name

The above shall also be provided on a flysheet inside the front cover of each volume. Draft O&M manuals may be presented in unprinted covers.

Four copies of draft O&M manuals are to be provided to the Project Manager; following approval 8 copies are to be provided to the Project Manager or his site Representative for each section of the works.

1.40 Site Storage Facilities

The Contractor shall provide lockable cabinets in each of the individual substations, which are to contain the following:

- (a) One set of paper prints of the complete record of drawings for the section of the work. These shall be arranged in a logical sequence in accordance with the drawing list contained in the O&M manuals. Record drawings are to be grouped into labeled pockets or binders to minimize disturbance in locating specific drawings. As-built drawings are to be stored in these locations prior to the issue of record drawings.
- (b) Two complete sets of O&M manuals
- (c) Volumes of factory and site test reports/certificates
- (d) Copies of maintenance log sheets, record sheets etc.
- (e) Space for stationery and operators' log books

These cabinets shall match other furnishings being provided in the substation and the location as such items is to be included in the design of the substation layout.

1.41 Switchyard Cable Ducts and Conduits

A system of UPVC conduits (equipment to duct) and pre-cast concrete ducts shall be used for control and LV cabling between switchyard equipment and the control building. Entry to the control/ protection panels in the building shall be via the top of the panels and a suitable sealing arrangement.

HV cabling between the transformers and switchgear panels shall be installed in concrete ducts in the switchyard and within the building. HV Cabling between the control building and the feeder termination poles shall be direct buried outside the building.

SCHEDULE -A

PARTICULAR SPECIFICATIONS

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BANGLADESH RURAL ELECTRIFICATION BOARD (BREB)
PEOPLE'S REPUBLIC OF BANGLADESH
STANDARD FOR SUB-STATION
OLTC TYPE THREE PHASE POWER TRANSFORMERS:
20 MVA

PART-1: GENERAL

1. SCOPE

The transformers shall be suitable for continuous operation on a three-phase 50 Hz high voltage transmission system as specified in the Schedule of Requirements.

The transformers shall be of the three phase oil immersed type and designed with particular attention to the suppression of harmonic especially the third and fifth harmonics and to minimize the detrimental effects resulting there from. All transformers shall be suitable for outdoor installation on concrete bases and shall be designed to operate satisfactorily in parallel with each other. The transformer shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of

The cooling for the transformers shall be ONAN/ONAF as specified.

2. REFERENCES

2.1 British Standards

BS 61	Specification for threads for light gauge copper tubes and fittings
BS 3600	Specification for dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes
BS 4504	Circular flanges for pipes, valves and fittings (PN designated)
BS 6121	Mechanical cable glands
BS 6346	Specification for PVC insulated cables for electricity supply
BS 6435	Specification for unfilled enclosures for the dry termination of HV cables for transformers and reactors
BS 7354	Code of practice for design of HV open terminal stations
BS 7613	Specification for hot rolled quenched and tempered weldable plates

2.2 BS European Standards

BS EN 10029 Specification for tolerances on dimensions, shape and mass for hot rolled steel plates 3mm thick and above

2.3 IEC Standards

IEC 76	Power transformers
IEC 137	Insulated bushings for ac voltages above 1000V
IEC 186	Voltage transformers
IEC 214	On load tap changers
IEC 228	Conductors of insulated cables
IEC 233	Tests on hollow insulators for use in electrical equipment
IEC 296	Specification for unused mineral insulating oils for transformers and switchgear
IEC 354	Loading guide for oil immersed power transformers
IEC 422	Supervision and maintenance guide for mineral insulating oils in electrical equipment
IEC 529	Degrees of protection provided by enclosures
IEC 551	Determination of transformer and reactor sound levels

3. CLIMATE DATA

Main climate data that must be taken into account for the goods will be the followings:

Climate	: Tropical, intense sunshine, heavy rain
Maximum Temperature	: 45°C
Minimum Temperature	: 03°C
Average daily Temperature	: 35°C
Average isokeraunic level	: 80 days/ year
Relative humidity	: 50-100%
Average annual rain fall	: 3454mm
Maximum wind velocity	: 200 km/hour
Altitude	: 300 meters above Sea level
Atmospherically, Mechanical and Chemical impurities:	Moderately polluted

The information is given solely as a guide for Tender and no responsibility for its Accuracy will be accepted not will any claim based on the above be entertained.

Transformer supplied under this contract will be installed in tropical locations that can be considered hostile to its proper operation. Particular problems that shall receive special consideration relate to operation in a humid environment and presence of insects and vermin.

4. SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics:

- Frequency : 50Hz
- Nominal system voltages : 33kV
11kV
400/230V
- Maximum system voltages : 33kV System 36kV
11kV System 12kV

LV System 440V

- Minimum LV voltage : 360V
- Nominal short circuit levels : 33kV System 31.5 kA
11kV System 31.5 kA
- Insulation levels:
1.2/50 ms impulse withstand
(positive and negative polarity) : 33kV System 170kV
11kV System 75kV
- Power frequency one minute
withstand (wet and dry) : 33kV System 70kV
11kV System 28kV
LV System 3kV
- Neutral earthing arrangements : 33kV System solidly earthed
11kV System solidly earthed
LV System solidly earthed

5. INSPECTION AND TESTING

During pre-delivery/ pre-shipment inspection; BREB's inspection team will witness the following test during factory test in manufacturer's factory premises:

1. Measurement of turn ration test;
2. Vector group test (check of phase displacement)
3. Measurement of winding resistance;
4. Measurement of no load loss & no-load current;
5. Measurement of impedance voltage & load loss;
6. Dielectric withstands test;
7. Transformer oil test;
8. Temperature rise test.
9. Impulse test.

Besides BREB's inspection team will perform some physical test during factory test:

1. Transformer tank sheet thickness (top bottom & side);
2. Hot dip galvanization test as per standard BS-729 of all bolts & nuts connected with transformer tank, conservator, radiator etc;
3. Dimension of bolted type bimetallic connector for H.T. and L.T. bushing;
4. Dimension of tanks;
5. Checking of creep age distance of HT/LT bushings.
6. Others visible parts as per approval drawing.

As and when the Purchaser is satisfied that any materials/equipment shall have passed the relevant tests, the Purchaser shall notify the contractor in writing to that effect.

Should any inspected/tested goods fail to conform to the specification, the Purchaser shall have the right to reject any of the items or complete batch if necessary. In that case the Supplier shall replace the goods make good them without any financial involvement to the

Purchaser. The inspection and testing shall be carried out again and all cost thereof shall be borne by the Supplier.

Nothing in this clause shall in any way release the supplier from any warranty or other obligations under the contract.

5.1 Type Tests:

The following shall be regarded as type tests. Supplier shall submit all Type test reports from internationally recognized independent testing laboratory along with bid proposal.

5.1.1 Type Tests (for Transformer):

- (a) Test of temperature rise.
- (b) Short circuit test.
- (c) Dielectric test: (Induced over voltage test, Lightning Impulse voltage withstand test, Power frequency voltage withstand test)

Temperature Rise, Short Circuit and Dielectric test (Induced over voltage test, Lightning Impulse voltage withstand test, Power frequency voltage withstand test) on one Transformer of each type and size (i.e. same KVA, KV, AMPS, Frequency, Impedance, Weight of the Core, Oil etc. with tolerance $\pm 5\%$) of Transformer. These all type tests shall be done on same Transformer.

5.1.2 HT Bushing type test:

- Dry or wet power-frequency voltage withstand test;
- Dry lightning impulse voltage withstand test;
- Temperature rise test ;
- Verification of thermal short-time current withstand;
- Cantilever load withstand test;
- Verification of dimensions.

5.2 Special Tests:

- a) Noise level measurement, in accordance with IEC Publication 551 using a precision sound level meter conforming to IEC Publication 651. In addition the test shall be repeated with narrow band filters for the harmonic frequencies from 100Hz. up to 350 Hz.
- b) Magnetic balance test.
- c) Dissolve gas test (for transformer oil).
- d) Harmonics measurement test.

5.2. Routine Tests

The following shall be regarded as routine tests and shall be carried out on each transformer.

- (a) Measurement of winding resistance at principal tap and two extreme taps.
- (b) Voltage-ratio measurement and check of vector group.
- (c) Measurement of the impedance voltage at principal tap and two extreme taps.
- (d) Measurement of the load loss.

- (e) Measurement of no-load loss and no-load current, including measurement of harmonics.
- (f) Applied voltage test to all auxiliary circuits.
- (g) Tests on on-load tap-changer (fully assembled on transformer).
- (h) Induced over-voltage withstand test. The voltage applied shall be the relevant power frequency voltage specified in the clause on Insulation Levels.
- (i) Separate source voltage withstand test. The applied voltage shall be the relevant power frequency voltage specified in the clause on Insulation Levels.
- (j) Polarization index test (1 minute and 10 minute). Index shall be not less than 1.3.
- (i) Dielectric withstands test;
- (j) Transformer oil test;

5.3. Routine Test Sequence

The sequence of tests shall be:

- (a) Winding resistance measurement, voltage ratio measurement and vector group check
- (b) Separate source voltage withstand test, induced over-voltage withstand test, **impulse test**.
- (c) Impedance voltage and loss measurements.
- (d) Tap changer test.
- (e) Tests on auxiliary circuits.

The following tests on site will be carried out under a different contract after plant is fully assembled:

- (a) Ratio and vector group checks.
- (b) Insulation resistance (HV-LV, HV-E, LV-E).
- (c) Oil tests.
- (d) Other necessary pre-commissioning tests.

The Supplier will be held responsible for any discrepancy or defect discovered during these tests and shall rectify immediately on receipt of notification at no cost to the Purchaser. The Supplier may at his own discretion witness site testing of transformers.

6. PACKING AND SHIPPING

6.1. Packing

The equipment and any supporting structures are to be transported adequately sealed against water ingress. All accessories and spares shall be packed and securely clamped against movement in robust, wooden, non-returnable packing cases to ensure safe transit in rough terrain, cross country road conditions and in heavy rains from the manufacturer's works to the work sites.

- individual serial number;
- purchaser's name;
- contract number;
- destination;
- a colour coded marking to indicate destination;

- supplier's name;
- name and address of supplier;
- description and numbers of contents;
- manufacturer's name
- country of origin;
- case measurements;
- gross and net weights in kilograms; and
- all necessary slinging and stacking instructions.

Each crate or container shall be marked clearly on the outside of the case to show TOP and BOTTOM positions with appropriate signs to indicate where the mass is bearing and the correct positions for slings. All component parts which are separately transported shall have permanent identification marks to facilitate correct matching and assembly at site. Welded parts shall be marked before welding. Six copies of each packing list shall be sent to the Purchaser prior to dispatching the equipment.

6.2. Shipping

The Supplier shall be responsible for the shipping of all plant and equipment supplied from abroad to the ports of entry and for the transport of all goods to the various specified destinations including customs clearance, off-loading, warehousing and insurance.

The Supplier shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Supplier shall also be responsible for verifying the access facilities specified.

The Supplier shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Supplier shall immediately report to the Purchaser any claims made against the Supplier arising out of alleged damage to a highway or bridge.

All transport accessories, such as riding lugs, jacking pads or blanking off plates shall become the property of the Purchaser. All items of equipment shall be securely clamped against movement to ensure safe transit from the manufacturer's facilities to the specified destinations.

The Supplier shall advise the storage requirements for any plant and equipment that may be delivered to the Purchaser's stores. The Supplier shall be required to accept responsibility for the advice given in so far as these arrangements may have a bearing on the behavior of the equipment in subsequent service.

6.3. Hazardous substances

The Supplier shall submit safety data sheets for all hazardous substances used with the equipment. The Supplier shall give an assurance that there are no other substances classified as hazardous in the equipment supplied. No oil shall be supplied or used at any stage of manufacture or test without a certificate acceptable to the Purchaser that it has a

PCB content zero. The Supplier shall accept responsibility for the disposal of such hazardous substances, should any be found.

The Supplier shall also be responsible for any injuries resulting from hazardous substances due to non-compliance with these requirements.

7. SUBMITTALS

7.1. Submittals required with the bid

The following shall be required with each copy of the bid :

- completed technical data schedule;
- descriptive literature giving full technical details with calculation of heat dissipation, radiator arrangement, no-load loss with considering flux density of equipment offered;
- outline dimension drawing for each major component, general arrangement drawing showing component layout and general schematic diagrams;
- type test certificates, where available, and sample routine test reports;
- list of recommended spare parts and consumable items for five years of operation with prices and spare parts catalogue with price list for future requirements.

7.2. Submittals required after contract award

7.2.1. Program

Five copies of the program for production and testing.

7.2.2. Technical Particulars

Within 30 days of contract award five bound folders with records of the technical particulars relating to the equipment. Each folder shall contain the following information:

- general description of the equipment and all components, including brochures;
- technical data schedule, with approved revisions;
- calculations to substantiate choice of electrical, structural, mechanical component size/ratings;
- detailed dimension drawing for all components, general arrangement drawing showing detailed component layout and detailed schematic and wiring drawings for all components;
- detailed loading drawing to enable the Purchaser to design and construct foundations for the transformer;
- detailed installation and commissioning instructions; at the final hold point for Purchaser approval prior to delivery of the equipment the following shall be submitted;
- inspection and test reports carried out in the manufacturer's works;
- operation and maintenance instructions as well as trouble shooting char

7.2.3. Operation and Maintenance instructions

The copy of installation and commissioning instructions and of the operation and maintenance instructions and troubleshooting charts shall be supplied with each transformer.

7.3. Drawings

Within 30 days of contract commencement the Supplier shall submit, for approval by the Purchaser, a schedule of the drawings to be produced detailing which are to be submitted for "Approval" and which are to be submitted "For Information Only". The schedule shall also provide a program of drawing submission, for approval by the Purchaser that ensures that all drawings and calculations are submitted within the period specified above. All detail drawings submitted for approval shall be to scale not less than 1:20. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings. All documents and drawings shall be submitted in accordance with the provisions of this specification and shall become the property of the Purchaser. All drawings and calculations, submitted to the Purchaser, shall be on international standard size paper, either A0, A1, A2, A3 or A4. All such drawings and calculations shall be provided with a contract title block, which shall include the name of the Purchaser and Consultants and shall be assigned a unique project drawing number; the contract title block and project numbering system shall be agreed with the Purchaser. Script sizes and thickness of scripts and lines be selected so that if reduced by two stages the alphanumeric characters and lines are still perfectly legible so as to facilitate microfilming. For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

8. SHIPMENT AND DRYING OUT

8.1 Shipment

Each transformer, when prepared for shipment, shall be fitted with a shock indicator or recorder which shall remain in situ until the transformer is delivered to Site. In the event that the transformer is found to have been subjected to excessive shock in transit, such examination as is necessary shall be made in the presence of the Engineer.

Where practicable, transformers shall be shipped with oil filling to cover core and windings but, when shipped under pressure of gas, shall be fitted for the duration of delivery to Site and for such time thereafter as is necessary, with a gauge and gas cylinder adequate to maintain internal pressure above atmospheric.

All earthing transformers shall be shipped full of oil.

8.2 Drying Out

All transformers shall be dried out by an approved method at the manufacturer's works and so arranged that they might be put into service without further drying out on Site. Clear instructions shall be included in the Maintenance Instructions regarding any special precautionary measures (e.g. strutting of tap changer barriers or tank cover) which must be taken before the specified vacuum treatment can be carried out. Any special equipment necessary to enable the transformer to withstand the treatment shall be provided with each transformer.

9. APPROVAL PROCEDURE

The Supplier shall submit all drawings, documents and type test reports for approval in sufficient time to permit modifications to be made if such are deemed necessary and resubmit them for approval without delaying the initial deliveries or completion of the contract work. The Purchaser's representative shall endeavor to return them within a period of four weeks from the date of receipt. Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. The Purchaser reserves the right to request any further additional information that may be considered necessary in order to fully review the drawings. If the Purchaser is satisfied with the drawing, one copy will be turned to the Supplier marked with "Approved" stamp. If the Purchaser is not totally satisfied with the drawing, then "Approved Subject to Comment" status will be given to it and a comment sheet will be sent to the Supplier. If the drawing submitted does not comply with the requirements of the specification then it will be given "Not Approved" status and a comment sheet will be sent to the Supplier. In both these cases the Supplier will have to modify the drawing, update the revision column and resubmit for final Approval. Following approval, twenty copies of the final drawings will be required by the Purchaser within the time allocated for design and drawing approval.

Any drawing or document submitted for information only should be indicated as such by the Supplier. Drawings and documents submitted for information only will not be returned to the Supplier unless the Purchaser considers that such drawing needs to be approved, in which case they will be returned suitably stamped with comments.

The Supplier shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Purchaser. Approval given by the Purchaser to any drawing shall not relieve the Supplier from his liability to complete contract works in accordance with this specification and the condition of contract nor exonerate him from any of his guarantees.

If the Supplier needs approval of any drawing within a period of less than four weeks in order to avoid delay in the completion of supply, he shall advise the Purchaser when submitting the drawings and provide an explanation of the document's late submission. The Purchaser will endeavor to comply with the Contractors timescale, but this cannot be guaranteed.

10. SURFACE TREATMENT

A full description of the corrosion prevention system proposed by the Bidder shall be given in the Schedule and this is subject to acceptance by the Purchaser. This description shall include details of surface preparation, rust inhibition, paint thickness, treatment of fasteners and painting of surfaces in contact with oil.

All machining, drilling, welding, engraving, scribing or other manufacturing activities which would damage the final surface treatment shall be completed before the specified surface treatment is carried out. Any subsequent damage occurring to the surface treatment up to the final delivery and offloading shall be made good by the Supplier.

10.1. Painting

All paints shall be applied on clean, dry surfaces under suitable atmospheric and other conditions in accordance with the paint manufacturer's instructions. All paints used shall be compatible with each other and capable of being used as a system. The system shall be capable of performance for five years in the environment specified without any need for maintenance. No consecutive coats of paint shall be of the same shade. The minimum standards acceptable are:

- Cleaning by shot blasting to Grade Sa 2.5 of ISO 8501-1.
- All sheet steelwork shall be degreased, pickled and phosphate in accordance with IS 6005 - "Code of Practice for phosphate of iron and steel."
- All rough surfaces of coatings shall be filled with an approved two pack filler and rubbed down to a smooth finish.
- Interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning and priming shall be painted with one coat of zinc chromate primer, one coat of phenolic based undercoating, followed by one coat of phenolic based finishing paint to white colour followed by a final coat of anti-condensation white paint of a type and make to the approval of the Purchaser. A minimum overall paint film thickness of 150 microns shall be maintained throughout.
- Exterior steel work and metalwork, after preparation and priming shall be painted with one coat of zinc chromate primer, one coat of phenolic based under coating and two coats of micaceous iron oxide paint, then painted with a final coat of phenolic based hard gloss finishing paint of the Light Grey Shade No 631 of IS 5, to provide an overall minimum paint thickness of 200 microns.

10.2. Galvanizing

All galvanizing shall be carried out by the hot dip process, in accordance with Specification ISO 1460 or IS 2629. However, high tensile steel nuts, bolts and spring washers shall be electro galvanized to service condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

Before pickling, all welding, drilling, cutting, grinding etc. must be completed and all grease, paint, varnish, oil, welding slag etc. completely removed. All protuberances which would affect the life of galvanizing shall also be removed.

The weight of zinc deposited shall be in accordance with that stated in standard BS 729 and shall be not less than 0.61 kg/sq. mtr with minimum thickness of 86 microns for items of thickness more than 5 mm, 0.46 kg/ sq. mtr. (64 microns) for items of thickness between 2 mm & 5 mm and 0.33 kg/ sq. mtr (47 microns) for items less than 2 mm thick. Parts shall not be galvanized if their shapes are such that the pickling solution cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint. In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Purchaser or that of his representative. Repair of galvanizing on site will generally not be permitted.

The threads of all galvanized bolts and screwed rods shall be cleared of splitter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Purchaser. All nuts and bolts shall be hot dip galvanized. Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust, galvanized material shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

PART-2: TECHNICAL

11. TYPE OF TRANSFORMER

The transformers shall be double copper wound, three phase, oil immersed, **33/11.55 kV**, 50 Hz with on-load tap-changer for 20/28 MVA Transformer

The transformers shall be naturally cooled type ONAN and forced cooled type ONAF.

12. RATED CAPACITY

The MVA ratings shall be 20/28 MVA based on ONAN/ONAF. Each transformer shall be capable of supplying its rated power continuously at all tap positions with rated voltage on the low voltage winding. The transformers shall also be capable of delivering rated current at an applied voltage equal to 105% of the rated voltage.

Each transformer shall be capable of supplying its rated power continuously under ambient temperature conditions without the temperature rise of the top oil exceeding 55°C and without the temperature rise of the windings as measured by resistance exceeding 60°C. The indicative ambient temperature conditions are as follows:

Maximum ambient temperature	45°C
Maximum daily average ambient temperature	35°C
Maximum yearly weighted average ambient temperature	32°C

13. VOLTAGE RATIO

Each transformer shall be supplied with an on load tap changer (as specified) connected to the high voltage winding. The tap changer shall have 17 tap positions and shall be so arranged as to give variations of transformation ratio in equal steps of 1.5% per step. The total range of the tap changer shall be from +6 percent to -18.0 percent. Tap 5 shall be the principal tap and the transformation ratio at tap 5 shall be 33.00 KV to 11.55 KV.

The no-load voltage ratios shall be as follows (for OLTC):

Tap No.	High Voltage	Low Voltage
1	34.98 kV	11.55kV
5	33.00kV	11.55kV

14. WINDING CONNECTIONS AND VECTOR GROUP

The transformers shall be connected in accordance with IEC Publication 76 as follows:

HV Winding : Delta connected.
 LV Winding : Star connected.
 Vector Group : Dyn 1

15. INSULATION LEVELS

The transformers shall be designed and tested to the following insulation levels:

Line Terminals	Power Frequency Voltage (rms.)	Lightning Impulse Voltage (peak)
33kV	70 kV	170 kV (1.2/50 μ sec.)
11kV	28 kV	75 kV (1.2/50 μ sec.)

The windings shall be uniformly insulated and the low voltage neutral point shall be insulated for full voltage.

16. IMPEDANCE VOLTAGE

The impedance on the principal tap shall be as follows:

20MVA	10.0%

The impedance voltage refers to the principal tapping. No negative tolerance on this percentage impedance is allowed. A positive tolerance of +10% is allowed.

Transformers of each rating shall have corresponding impedance per tap characteristics such that transformers of the same rating can be operated in parallel.

17. SHORT CIRCUIT PERFORMANCE

The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits, as specified in IEC 76-5 'Ability to withstand short circuits'.

Each transformer shall be capable of withstanding for 2 seconds a bolted metallic short circuit on the terminals of either winding with rated voltage on the other winding and the tap-changer in any position.

Short circuit tests shall have been carried out on the particular design of transformer offered, the test results shall be supplied with the bid.

18. REGULATION

The regulation of each transformer from no-load to continuous rated output at 1.0 power factor and at 0.85 lagging power factor shall be as guaranteed in the Technical Data Schedules.

19. FLUX DENSITY

Each transformer shall be capable of operating continuously with rated current and with system maximum voltage applied to the low voltage winding at a frequency of 96 per cent of rated frequency without exceeding the temperature rise specified in Clause 12.

The limit of flux density at normal voltage and frequency shall be subject to the requirements for losses, harmonics and noise suppression but in any event shall not exceed 1.6 Tesla.

The transformer core shall not be saturated at maximum system voltage i.e. 36 kV.

20. HARMONIC CURRENTS

The transformers shall be designed with particular attention to the suppression of harmonic voltages, especially the 3rd, 5th and 7th harmonics, so as to eliminate wave form distortion and the possibility of high frequency disturbances, induction effect or of circulating current between neutral points at different transformer stations.

21. PARTIAL DISCHARGE

Each transformer shall be partial discharge free up to 120% of rated voltage as the voltage is reduced from 150% of rated voltage i.e. there shall be no significant rise above background level.

22. VOLTAGE CONTROL

22.1 General

Transformers shall be provided with tap changers for varying the effective transformation ratio. Control schemes shall utilize 110V ac centre tap earthed voltage derived from the LV 3-Phase, 4-Wire system. Phase failure relays shall be provided to ensure a secure supply. Winding taps as called for in the Technical Requirements and Guarantee Schedule shall be provided on the high voltage winding.

All terminals shall be clearly and permanently marked with numbers corresponding to the cables connected thereto.

Tap positions shall be numbered consecutively, ranging from one upwards. The tap positions shall be numbered so that by raising the tap position the LV voltage is increased

22.2 On-Load Tap Changers

22.2.1 General

On-load tap changers are according as per IEC 60214 and be from MR, Germany/ ABB, Sweden/ Hitachi Energy, Sweden in order to comply with existing equipment standards. The On-Load Tap Changers shall be Vacuum Type.

Current making and breaking switches associated with the tap selectors or otherwise where combined with tap selectors shall be contained in a tank in which the head of oil is maintained by means completely independent of that on the transformer itself. Details of maintaining oil separation, oil levels, and detection of oil surges and provision of alarm and trip contacts shall be dependent on the design of tap-changer and be to the approval of the Engineer.

22.2.2 Mechanisms

The tap change mechanism shall be designed such that when a tap change has been initiated, it will be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during tap change or any other contingency would result in that movement not being completed an approved means shall be provided to safeguard the transformer and its auxiliary equipment.

Limit switches shall be provided to prevent over-running of the tap changing mechanism. These shall be directly connected in the operating motor circuit. In addition, mechanical stops shall be fitted to prevent over-running of the mechanism under any conditions. For on-load tap change equipment these stops shall withstand the full torque of the driving mechanism without damage to the tap change equipment.

Thermal devices or other approved means shall be provided to protect the motor and control circuit.

A permanently legible lubrication chart shall be provided and fitted inside the tap change mechanism chamber.

22.2.3 Local and Remote Control

Equipment for local manual and electrical operation shall be provided in an indoor cubicle complying with Section-2. A thermostat controlled anti-condensation heater is to be provided in the cubicle. Electrical remote control equipment shall also be supplied as specified.

The following operating conditions are to apply to the on-load tap changer controls:-

- a) It must not be possible to operate the electric drive when the manual operating gear is in use.
- b) It must not be possible for two electric control points to be in operation at the same time.
- c) Operation from the local or remote control switch shall cause one tap movement only, unless the control switch is returned to the off position between successive operations.
- d) It must not be possible for any transformer operating in parallel with one or more transformers in a group to be more than one tap out of step with the other transformers in the group.

- e) All electrical control switches and local manual operating gear shall be clearly labeled in an approved manner to indicate the direction of tap changing, i.e. raise and lower tap number.
- f) Emergency stop push-button at local and remote control positions.

22.2.4 Indication

Apparatus of an approved type shall be provided on each transformer:

- a) To give indication mechanically at the transformer and electrically at the remote control point of the number of the tapping in use.
- b) To give electrical indication, separate from that specified above, of tap position.
- c) To give indication at the remote control point that a tap change is in progress; this indication to continue until the tap change is completed.
- d) To give indication at the remote control point when the transformers operating in parallel are operation out of step.
- e) To indicate at the tap change mechanism the number of operations completed by the equipment.

22.4 Automatic Voltage Control

Automatic Voltage Control Relay shall be from 'MR' Germany/ABB, Sweden/ Hitachi Energy, Sweden which is also suitable for control of transformers in parallel. This Automatic Voltage Control Relay should have the IEC 61850 protocol type. This relay shall be capable for SCADA operation. Automatic Voltage Control Relay shall be from same manufacturer of OLTC.

In addition to the methods of control included in this specification, the following methods shall also be provided. This is for future addition of a similar transformer and associated parallel operation.

- a) Automatic Independent – It shall be possible to select automatic independent control for each transformer irrespective of the method of control selected for any other of the associated transformers.
- b) Automatic parallel – It shall be possible to select any transformer for master or follower control. It must not be possible to operate any tap changer by remote or local electrical manual control while the equipment is switched for automatic operation.

22.4.1 Voltage Regulating Relays

Automatic voltage control shall be initiated by a voltage regulating relay of an approved type and suitable for flush mounting. The relay shall operate from the nominal reference voltage stated in the Schedule of Requirements derived from a circuit mounted LV voltage transformer having Class 1.0 accuracy to IEC 60186 and the relay voltage reference balance point shall be adjustable.

The relay bandwidth shall preferably be adjustable to any value between 1.5 times and 2.5 times the transformer tap step percentage, the nominal setting being twice the transformer tap step percentage.

The relay shall be insensitive to frequency variation between the limits of 47Hz and 51Hz. The relay shall be complete with a time delay element adjustable between 10 and 120 seconds. The relay shall also incorporate an under voltage blocking facility which renders the control inoperative if the reference voltage falls below 80 percent of the nominal value with automatic restoration of control when the reference voltage rises to 85 percent of nominal value.

On each transformer the voltage transformer supply to the voltage regulating relay shall be monitored for partial or complete failure. The specified indicating lamp and alarm will be inoperative when the circuit- breaker controlling the lower voltage side of the transformer is open and also that when the tap changer is on control other than automatic control.

23. COOLING AND TEMPERATURE CONTROL

The banks of cooling radiators shall be detachable from the tank for transport and maintenance. Shut-off valves shall be provided on the tanks of the transformers for this purpose. An air-vent and draining plug shall be provided on each radiator bank. All external surfaces of the radiators shall be hot dip galvanized as specified in Sub-clause 13.2, Part 1 of this document. Temperature control equipment shall be housed in a local control box mounted on the side of the transformer. A 150mm diameter dial thermometer shall be provided to indicate the temperature of the top oil in the transformer. This thermometer shall be fitted in such a way that it can easily be read from ground level through a window in the door of the control box. The thermometer shall be fitted with two adjustable contacts, one connected to give an alarm and one to trip associated circuit breakers. It shall also be fitted with a maximum temperature pointer which shall be re-settable by hand.

A similar dial thermometer shall be provided in the control box to indicate winding temperature. This thermometer shall have two sets of adjustable contacts one connected to give an alarm and the other to trip associated circuit breakers and a maximum temperature pointer which shall be re-settable by hand. The minimum range of these contacts shall be 50°C to 100°C for alarm and 60°C to 120°C for trip. The temperature control box shall be weatherproofed to IP55 of IEC 529 or IS 2147 equivalent.

23.1 Cooling Plant

23.1.1 General

Radiators and coolers shall be hot-dip galvanized, designed so that all painted surfaces can be thoroughly cleaned and easily painted in situ with brush or spray gun. The design shall also avoid pockets in which water can collect and shall be capable of withstanding the pressure tests specified in the schedule of requirements for the transformer main tank.

The clearance between any oil or other pipe work and live parts shall be not less than the minimum clearances stated in the Schedule of Requirements.

23.1.2 Radiators connected directly to Tank

Where built-on radiators are used, each radiator shall be connected to the main tank through flanged valves. Plugs shall be fitted at the top of each radiator for air release and at the bottom for draining.

A valve shall be provided on the tank at each point of connection to the tank.

23.1.3 Cooler Banks

Each cooler bank shall be provided with:-

- A) A valve at each point of connection to the tank.
- B) A valve at each point of connection of radiators
- C) Loose blanking plates for blanking off the main oil connections.
- D) A 50mm filter valve at the top of each cooler bank.
- E) A 50mm drain valve at the lowest point of each interconnecting oil pipe.
- F) A thermometer pocket, fitted with captive screw cap in the inlet and in the outlet oil pipes.
- G) Air release and drain plugs on each radiator.

The omission of any, or the provision of alternative, arrangements to the above requirements will not be accepted unless approved in writing by the Engineer before manufacture.

23.1.4 Forced Cooling

The type of forced cooling shall be as stated in the Schedule of Requirements. Forced cooling equipment of transformers of similar rating and design shall be completely interchangeable, one with the other, without modification on Site.

23.1.5 Oil Pipes and Flanges

All oil piping necessary for the connecting of each transformer to its conservator, cooler banks etc. shall be supplied and erected under this Contract.

The oil piping shall be of approved material with machined flanged joints. Copper pipe work is to comply with BS 61.

Dimensions of steel pipes shall be in accordance with BS 3600 and the drilling of all pipe flanges shall with BS 4504.

An approved expansion piece shall be provided in each oil pipe connection between the transformer and each oil cooler bank.

All necessary pipe supports, foundation bolts and other attachments are to be provided.

It shall be possible to drain any section of pipe work independently of the rest and drain valves or plugs shall be provided as necessary to meet this requirement.

23.1.6 Air Blowers

Air blowers for forced air-cooling shall be of approved make and design and be suitable for continuous operation out-of-doors. They shall also be capable of withstanding the stresses imposed when brought up to speed by the direct application of full line voltage to the motor.

To reduce noise to the practical minimum, motors shall be mounted independently from the coolers, alternatively, an approved form of anti-vibration mounting shall be provided.

It shall be possible to remove the blower, complete with motor, without disturbing or dismantling the cooler structure framework.

Blades shall be of material subject to approval.

Blower casings shall be made of galvanized steel of thickness not less than 2.6 mm (14 S.W.G.) and shall be suitably stiffened by angles or tees.

Galvanized wire guards with mesh not exceeding 12.5mm shall be provided to prevent accidental contact with the blades. Guards shall also be provided over all moving parts. Guards shall be designed such that blades and other moving parts cannot be touched by test fingers to IEC 529.

23.1.7 Cooler Control

Where forced cooling using multiple small single-phase motors is employed, the motors in each cooling bank shall be grouped so as to form a balanced three-phase load.

Each motor or group of motors shall be provided with a three-pole electrically operated contractor and with control gear of approved design for starting and stopping manually.

Where forced cooling is used on transformers, provision shall be included under this contract for automatic starting and stopping from contacts on the winding temperature indicating devices as specified. The control equipment shall be provided with a short time delay device to prevent the starting of more than one motor, or group of motors in the case of multiple cooling, at a time.

Where motors are operated in groups, the group protection shall be arranged so that it will operate satisfactorily in the event of a fault occurring in a single motor.

The control arrangements are to be designed to prevent the starting of motors totaling more than 15 KW simultaneously, either manually or automatically. Phase failure relays are to be provided in the main cooler supply circuit.

All contacts and other parts which may require periodic renewal, adjustment or inspection shall be readily accessible.

All wiring for the control gear accommodated in the marshalling kiosk, together with all necessary cable boxes and terminations and all wiring between the marshalling kiosk and the motors, shall be included in the contract. Each box shall have a hinged gasketed door

lockable by padlock. Solar gain can give rise to high temperature in a local control box. Adequate ventilation shall be provided to ensure that all equipment contained therein shall operate satisfactorily under these conditions.

A terminal block with 10% spare terminals shall be provided in each temperature control box.

24. TANK AND ACCESSORIES

24.1 General

The transformer tank shall be skid mounted type. The transformer tank shall be designed so that the complete transformer with oil and excluding conservator and radiators can be lifted and transported without permanent deformation or oil leakage. The tank and cover including the stiffeners shall be designed in such a manner as to leave no external pockets in which water can lodge, or internal pockets where gas/air can collect. All fittings shall be designed so as to prevent entry of air or leakage of oil from the tank. All pipes, shall be externally welded to the tank wall. The tank and cover shall be of structural quality, weldable high tensile steel with a minimum thickness of 3mm. All welding shall be stress relieved. The requirement of post weld heat treatment of tank/ stress relieving shall be based on recommendation of BS-5500.

The tank lid shall not be welded shut, but shall be secured by bolts and provided with suitable oil-tight gasket. The tank is to withstand vacuum up to 500mm of mercury for 20 MVA transformers and any pressure of oil developed during operation conditions including short circuits.

24.2 Surface Treatment

The transformer tank and accessories shall be adequately protected against corrosion. The inside of the tank shall be painted with an approved oil resisting varnish. The outside of the tank shall be painted as specified in Sub-clause 13.1, Part 1 of this document.

Conservator Tank:

A conservator tank shall be provided of adequate capacity between lowest and highest visible levels to meet expansion of oil from 0°C to 100°C. A suitable oil level gauge shall be located on the tank so that it can be easily read from ground level. The gauge shall be graduated for temperatures of 0°C, +45°C and +90°C.

Each gauge shall be provided with contacts for separate low oil level alarm and trip signals. The conservator shall be fitted with a filling hole with cap and drain valve. It shall be inclined at about 5 degrees towards the drain valve. The pipe connecting the conservator to the main tank shall project 20mm above the bottom of the conservator for collection of impurities.

24.3 Breather

The conservator tank shall be fitted with a breather in which silica gel is the dehydrating agent from any country of Europe, USA and Japan. The breather shall be a molded type transparent case of adequate size and so designed that:

- the passage of air through the silica gel does not give rise to any excess pressure rise;
- silica gel crystal of not less than 5mm. size is used;
- the silica gel is sealed from the external atmosphere by means of an oil seal;
- the moisture absorption indicated by a change in color of the crystals can be easily observed from a distance;
- the breather mounting height facilitates maintenance from ground level without switching out the transformer.

24.4 Explosion Vent or Pressure Relief Device

An explosion vent or pressure relief device shall be provided to release any severe build-up of pressure within the tank. The vent shall be designed such that in the event of an explosion, rain, sand or any other foreign bodies are prevented from getting into the tank. The vent shall be positioned so as to direct the explosion safely into the oil pit.

24.5 Oil Sampling Devices

Oil sampling devices shall be fitted to the main tank. They shall be located suitably for easy access especially during maintenance, one near the bottom of the tank and one near the top.

24.6 Oil Filtration

Two 50mm bore filter valves shall be fitted to the tank, one on the top and the other diagonally opposite on the bottom.

24.7 Lifting Lugs/Eyes

Lifting lugs shall be provided for supporting the weight of the transformer including core and windings and fittings and with the tank filled with oil.

24.8 Jacking Pads

Four jacking pads shall be provided near the corners of the tank of each transformer and approximately 400mm above the lowest part of the tank. These pads shall be designed to take the complete weight of the transformer filled with oil.

24.9 Hauling Eyes

Hauling eyes shall be provided on all sides of the transformer.

24.10 Earthing Terminals

Earthing terminals shall be provided on the transformer close to each of the four corners of the tank to facilitate easy earthing of the transformer on site.

24.11 Oil Valves

In addition to the valves already mentioned, a drain valve shall be provided near the bottom of the tank. All oil valves shall be provided with means for securing them in the open or closed position.

25. TERMINAL BUSHING AND CONNECTIONS

25.1 General

Transformers are to be provided with outdoor type bushing insulators and cable box on the LV side. HV and LV bushings shall be from Europe, USA or Japan. All bushings shall comply with IEC 60137 and the minimum creepage distance for outdoor bushings shall not be less than 25mm per kV of rated voltage between phases. Outdoor bushing insulators shall be provided with adjustable arcing horns and for rated voltages of 36 kV and lower these shall be of the duplex gap type.

Bushings shall be of sealed construction suitable for service under the very humid conditions at site and, in addition, for the very rapid cooling of equipment exposed to direct sunlight when this is followed by sudden heavy rainstorms.

Typical sections of bushing insulators showing the internal construction, method of securing the top cap and methods of sealing shall be included in the Tender.

Completely immersed bushings and lower voltage outdoor immersed bushings may be of other type of construction, subject to the approval of the Engineer but bushings of resin bonded paper construction are not permitted. The 33 kV bushings shall be porcelain (solid or condenser type). On all condenser bushings a tapping shall be brought out to a separate terminal for testing purposes on Site.

Special precautions shall be taken to exclude moisture from any paper insulation during manufacture, assembly, transport and erection. Terminal arrangement of LV cable box position & neutral bushing position shall be as per approved drawings.

25.2 Porcelain

Hollow porcelain shall meet the test requirements of IEC 60233 and shall be sound, free from defects and thoroughly vitrified. Designs based on jointed porcelains will not be acceptable. The glaze must not be depended upon for insulation. The glaze shall be smooth, hard, of a uniform shade of brown and shall cover completely all exposed parts of the insulator. Outdoor insulators and fittings shall be unaffected by atmospheric conditions producing weathering, acids, alkalis, dust and rapid changes in temperature that may be experienced under working conditions.

The porcelain must not engage directly with hard metal and, where necessary, gaskets shall be interposed between the porcelain and the fittings. All porcelain clamping surfaces in contact with gaskets shall be accurately ground and free from glaze.

All fixing material used shall be of suitable quality and properly applied and must not enter into chemical action with the metal parts or cause fracture by expansion in service. Cement thickness are to as small and even as possible and proper care is to be taken to centre and locate the individual parts correctly during cementing.

All porcelain insulators shall be designed to facilitate cleaning.

25.3 Marking

Each porcelain insulator shall have marked upon it the manufacturer's name or identification mark and year of manufacture. These marks shall be clearly legible after assemble of fittings and shall be imprinted before firing, not impressed.

When a batch of insulators bearing a certain identification mark has been rejected, no further insulators bearing this mark shall be submitted and the Contractor shall satisfy the Engineer that adequate steps will be taken to mark or segregate the insulators constituting the rejected batch in such a way that there can be no possibility of the insulators being re-submitted for the test or supplied for the use of the Employer.

Each complete bushing shall be marked with the manufacturer's name or identification mark, year of manufacture, serial number, electrical and mechanical characteristics in accordance with IEC 60137.

25.4 Mounting of Bushings

Bushing insulators shall be mounted on the tank in a manner such that the external connections can be taken away clear of all obstacles. Neutral bushings shall be mounted in a position from which connection can be taken to a neutral current transformer mounted on a bracket secured to the transformer tank. The current transformer will be supplied by the switchgear manufacturer but provision shall be made on the tank for mounting to the Engineer's requirements.

The clearances from phase to earth must not be less than those stated in the Technical Requirements and Guarantee Schedule.

A flexible pull-through lead suitably suited to the end of the winding copper shall be provided for the bushings and is to be continuous to the connector which is housed in the helmet of the bushings. When bushings with an under-oil end of a re-entrant type are used the associated flexible pull-through lead is to be fitted with suitably designed gas bubble deflector. The bushing flanges must not be of re-entrant shape which may trap air.

Clamps and fittings made of steel or malleable iron shall be galvanized and all bolt threads are to be greased before erection.

25.5 Tests

Routine, sample and type tests of Bushing shall be carried out in accordance with the specified standards. Type tests shall also be carried out unless approved type test evidence is submitted. These tests shall include temperature cycle and porosity tests.

The following standards shall apply:-

- IEC 60233(BS 4963) for hollow porcelains.
- IEC 60137 for bushings.
- IEC 60148 and 60273 (BS 3297) for high voltage post insulators.
- IEC 60383 and 60305 (BS 137 Part 1 and Part 2) for cap and pin string insulators.

26. CORE AND WINDINGS

26.1 General

The winding shall be of high-conductivity electrolytic copper and transposed winding conductors shall be employed where applicable. Maximum current density for HV and LV windings should not exceed 2.5 A/mm².

The Windings shall have uniform insulation as defined in IEC 76. All neutral points shall be grounded.

The windings shall be located in a manner which will ensure that they remain electro-magnetically balanced and that their magnetic centers remain coincident under all conditions of operation.

The windings shall also be thoroughly dried and shrunk by the application of axial pressure for such length of time as will ensure that further shrinkage will not occur in service.

The windings and leads of all transformers shall be braced to withstand the shocks which may occur through rough handling and vibration during transport, switching and other transient service conditions including external short circuit

26.2 Core

The core shall be constructed from high grade, non-ageing, cold rolled grain oriented silicon steel laminations or superior material. The core and winding shall be capable of withstanding shocks during transport, installation and service. Provision shall be made to prevent movement of the core and windings relative to the tank during these conditions and also during short circuits.

The design shall avoid the presence of pockets which would prevent the complete emptying of the tank through the drain valve.

26.3 Windings

The winding conductor shall be of electrolytic copper, free from burs and splinter. Paper shall be used for conductor insulation. The insulation shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse. It shall be non catalytic and chemically inert in transformer oil during normal service.

The stacks of windings are to receive adequate shrinkage treatment.

The windings and connections are to be braced to withstand shocks during transport, switching, short circuit or other transient conditions. The manufacturer must provide the thermal damage curve or thermal damage description of the transformer winding or the transformer as per relevant IEC standard.

The winding shall be of electrolytic copper, free from burs and splinter. Paper shall be used for conductor insulation.

27. INTERNAL EARTHING

27.1 General

All metal parts of the transformer, with the exception of the individual core laminations, core bolts and associated individual clamping plates, shall be maintained fixed potential.

27.2 Earthing of Core clamping Structure

The top main core clamping structure shall be connected to the tank body by a copper strap. The bottom main core clamping structure shall be earthed by one or more of the following methods:

- a) by connection through vertical tie rods to the top structure;
- b) by direct metal- to- metal contact with the tank base maintained by the weight of the core and windings;
- c) by connection to the top structure on the same side of the core as the main earth connection to the tank.

27.3 Earthing of Magnetic Circuits

The magnetic circuit shall be earthed to the clamping structure at one point only through a removable link placed in an accessible position just beneath an inspection opening in the tank cover and which, by disconnection, will enable the insulation between the core and clamping plates, etc., to be tested at voltages up to 2 kV. The link shall have no detachable components and the connection to the link shall be on the same side of the core as the main earth connection. These requirements are compulsory.

All insulating barriers within magnetic circuits shall be bridged by means of aluminum or tinned copper strips, so inserted as to maintain electrical continuity.

27.4 Earthing of Coil Clamping Rings

Where coil clamping rings are of metal at earth potential, each ring shall be connected to the adjacent core clamping structure on the same side of the transformer as the main earth connection.

27.5 Size of Earthing connections

Main earthing connections shall have a cross-sectional area of not less than 80 sq.mm but connections inserted between laminations may have cross-sectional areas reduced to 20 sq.mm when in close thermal contact with the core.

28. TANKS AND ANCILLARY EQUIPMENT

28.1 Transformer Tanks

Each transformer shall be enclosed in a suitably stiffened weld-able high tensile steel tank such that the transformer can be lifted and transported without permanent deformation or oil leakage. The construction shall employ weld-able structural high tensile steel of an approved grade to BS 7613 and BS EN10029. The final coat colour of Transformers shall be to Munsell notation N5Y-7/I.

Lifting lugs shall be provided, suitable for the weight of the transformer, including core and windings, fittings, and with the tank filled with oil. Each tank shall be provided with at least four jacking lugs, and where required, with lugs suitably positioned for transport on a beam transporter. Haulage lugs should also be provided to enable a cable to be used safely for haulage in any direction.

The transformer tank shall be capable of withstanding vacuum up to 500mm of mercury without defection exceeding the value stated in the Schedule of Requirements.

Where the design of the tank is such that the bottom plates will be in direct contact with the surface of the foundations. The base of each tank shall be so designed that it is possible to move the complete transformer unit in any direction without injury when using rollers, plates, or rails

All joints, other than those which may have to be broken, shall be welded.

The tank and cover shall be designed in such a manner as to leave no external pockets in which water can lodge, no internal pockets in which oil can remain when draining the tank or in which air can be trapped when filling the tank, and to provide easy access to all external surfaces for painting. Where cooling tubes are used, each tube shall be of heavy gauge steel welded into the tank sides, top and bottom.

Each tank cover shall be of adequate strength, must not distort when lifted and shall be provided with suitable flanges having sufficient and properly spaced bolts. Inspection openings shall be provided to give access to the internal connections of bushings, winding connections and earthing links. Each opening shall be correctly located and must be of ample size for the purpose for which it is intended. All inspection covers shall be provided with lifting handles.

It must be possible to remove any bushing without removing the tank cover.

Pockets shall be provided for a stem type thermometer and for the bulbs of temperature indicators where specified. These pockets shall be located in the position of maximum

oil temperature and it must be possible to remove any bulb without lowering the oil level in the tank. Captive screwed caps shall be provided to prevent the ingress of water to the thermometer pockets when they are not in use. Where called for in the Technical Requirements and Guarantee Schedule, accommodation shall be provided for outdoor weatherproof neutral current transformers.

A ladder shall be provided on one side of the tank as a means for inspection and access to the top of the transformer. The lower section of the ladder shall be equipped with a barrier complete with provision for locking with a padlock.

28.2 Conservator Tanks, Breathers and Air Dryers

Each transformer shall be provided with an overhead conservator tank formed of substantial steel plates and arranged above the highest point of the oil circulating system. Connections into the main tank shall be at the highest point to prevent the trapping of air or gas under the main tank cover. A steel ladder shall be fixed between conservator top and the transformer top cover.

The capacity of each conservator tank shall be adequate for the expansion and contraction of oil in the whole system under the specified operating conditions. Conservator tanks shall also be provided with a cleaning door, filling cap, drain valve with captive cap and an oil level indicator with minimum and maximum levels indicated. The normal level at an oil temperature of 25°C shall be indicated and the minimum and maximum levels shall also be correlated with oil temperature markings. The temperature markings shall preferably be integral with the level indicating device. The Oil level indicator shall be from MR. Germany or equivalent European class.

The location of the conservator tank shall be so arranged that it does not obstruct the passage of high voltage conductors immediately above the transformer.

The pipe work between the conservator and the transformer tank shall comply with the standard requirements and a valve shall be provided at the conservator to cut-off the oil supply to the tank.

Each conservator shall be fitted with an air cell which shall be connected to a silica gel breather of a type which permits the silica gel content to be removed for drying. Due to the climatic conditions at site, this breather shall be larger than would be fitted for use in a temperate climate. All breathers shall be mounted at a height of approximately 1400 mm above ground level. The silica gel container shall be fully transparent.

28.3 Valves

Each transformer shall be fitted with the following valves as a minimum requirement:

28.3.1 Main Tank

- a) One 50mm bore filter valve located near to the top of the tank.
- b) One 50 mm bore filter valve located near to the bottom of the tank and diagonally opposite to the filter valve required against (A). Where design permits, this valve may be combined with item (C).

c) One 50mm drain valve with such arrangements as may be necessary inside the tank to ensure that the tank can be completely drained of oil as far as practicable. This valve shall also be provided with an approved oil sampling device.

d) One valve between the main tank and gas actuated relay, complete with bypass facility to facilitate removal of relay and maintain oil flow.

28.3.2 Conservator

a) One valve between the conservator and gas actuated relay for the main tank and where appropriate, for the tap change diverter switch tank complete with bypass for Buchholz relay to facilitate maintenance of the relay.

b) One drain valve for oil conservator tank so arranged that the tank can be completely drained of all oil.

28.3.3 Radiators and Cooler Banks

a) Valves at each point of connection to the tank.

The two valves 28.3.1 (d) and 28.3.2 (a) arrangement across the gas actuated relay are to be connected with an oil pipe work bypass facility to facilitate removal of the relay, due to failure etc, and still maintain the oil flow system between the conservator and main tank.

Blank flanges, plates or captive screw caps shall be fitted to all valves and pipe ends not normally connected in service.

The omission of any, or the provision of alternative arrangements to the above requirements, will not be accepted unless approved in writing by the Engineer before manufacture.

28.4 Joints and Gaskets

All joint faces shall be arranged to prevent the ingress of water or leakage of oil with a minimum of gasket surface exposed to the action of oil or air.

Oil resisting synthetic rubber gaskets are not permissible except where the synthetic rubber is used as a bonding medium for cork, or where metal inserts are provided to limit compression.

Gaskets shall have sufficient thickness consistent with the provision of a good seal and full details of all gasket sealing arrangements shall be shown on the Plant drawings.

All gaskets shall be closed design (without open ends) and shall be one piece only. Exterior gaskets shall be weatherproof and shall not be affected by strong sunlight. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. No gaskets shall be used in which the material of the

gasket is mounted on a textile backing. Gaskets of neoprene or any kind of impregnated/ bonded core or cork only which can easily damage by over pressing is not acceptable. Use of hemp as gasket material is also not acceptable.

28.5 Pressure Relief device

An approved pressure relief device of sufficient size for the rapid release of over pressure that may be generated in the tank, and designed to operate at a static pressure lower than the hydraulic test pressure, shall be provided. It shall be of the spring operated valve type and shall be provided with one set of normally open signaling contacts which will be used for trip alarm purposes. The pressure relief device shall be from 'MR' or equivalent European made.

The relief device is to be mounted on the tank cover and is to be provided with a skirt to project at least 25mm into the tank to prevent gas accumulation. Discharge of oil shall be directed away from the transformer top cover and clear of any operating position.

28.6 Earthing Terminals

Two substantial steel flag type terminals having two 14mm diameter holes on 55mm centers shall be located one on either side and near to the bottom of the transformer to facilitate connection to the local earthing system.

28.7 Rating, Diagram and Valve Plates

The following plates, or an approved combined plate, shall be fixed to each transformer tank at an average height of 1500mm above the ground level:-

- a) A rating plate bearing the data specified in IEC 76 Part 1. This plate shall also include the short-circuit current rating and time-factor for each winding.
- b) A Diagram plate showing in an approved manner the internal connections and the voltage vector relationship of the several windings, in accordance with IEC 76 Part1 with the transformer voltage ratio for each tap and, in addition a plan view of the transformer giving the correct physical relationship of the terminals.
- c) A plate showing the location and function of all valves and air release cocks or plugs. This plate shall also if necessary warn operators to refer to the Maintenance Instructions before applying vacuum.

Plates are to be of stainless steel or other approved material capable of withstanding the rigorous of continuous outdoor service at site.

29. STATION AUXILIARY TRANSFORMER:

Auxiliary transformers shall be sealed, two- electrolytic Cu winding, three-phase, oil immersed, ONAN, with Off Load Tap Changing, suitable for outdoor use.

All transformers shall be 33/0.415kV and have a continuous rating of 100 kVA, shall be capable of supplying the maximum continuous rating for all tap positions and maintaining rated voltage on the low voltage winding, under the maximum ambient temperature conditions, without the temperature rise of the top oil exceeding 55°C or the temperature rise of the windings as measured by resistance exceeding 60°C.

Transformers shall be in accordance with the relevant IEC standard and this specification. Refer to the Schedule of Technical Particulars and Guarantees for other relevant requirements.

Off-load tap-changing shall be carried out by means of an external hand-operated tapping switch mounted on the side of the tank. All phases of the tapping switch must be operated by one hand wheel.

The tapping switch shall have a spring-loaded captive bolt or other approved means on the moving part which positively locates the switch correctly at each tapping position. This bolt must be lockable at each tapping position and shall be provided with a suitable padlock and keys. Moving the switch from one tapping position to another shall require that the bolt be withdrawn by hand from its locating socket on the transformer tank against the spring pressure.

Tap-position numbers corresponding to the tapping switch bolt-locating sockets shall be cast or engraved in a metal indication plate fixed to the tank and a keyed metal pointer on the tapping switch operating handle shall show clearly at which tapping number the transformer is operating.

All tap-position indicators shall be marked with one integer for each tap position, beginning at number 1. Adjacent taps shall be numbered consecutively in such a manner that when moving a tap to a new tapping position which has a higher number, the no-load output voltage of the untapped winding increases.

29.1 Technical Requirements

Transformers shall be provided with the following fittings:

- Off-load tap changer.
- Oil filler plug and drain valve.
- Thermometer.
- Pressure release device.
- Four lifting lugs.
- Air insulated terminals for 33kV and 0.415 kV connections using adequately sized conductor.
- Galvanised tank and radiators.

30. CABLE TERMINATIONS AND GLANDS

30.1 Cable Boxes

The transformers shall be provided with cable boxes with all necessary fittings and attachments **as** per approval of Drawings (submitted by the bidder) by the proper authority of BREB . Cable boxes shall be of adequate proportions and designed in accordance with BS 6435 in such the manner that they can be opened for inspection without disturbing the gland plate or incoming cable(s). Cable boxes shall be designed for

ease of access for jointing and connecting the cable. They shall be constructed to minimize the danger of fragmentation; cast iron boxes shall not be used. The cable box shall be of such a design as to prevent ingress of moisture. Where blind tapped holes have to be provided, studs shall be used and not bolts or set screws.

All gaskets, unless otherwise approved, shall be in one continuous piece without joints. Gaskets shall not be compressed before use. Provision shall be made for earthing the body of each cable box. Removable blank gland plates and suitable type and size of cable glands shall be supplied and fitted for termination of the cables.

Dehydrating breather and draining holes protected by 1 mm aperture mesh shall be incorporated at the base of the box to avoid moisture condensation within cable box and ensure drainage of condensation respectively. Cable boxes shall be provided with suitable means for clamping the armor wires of the cables.

Gland plates for single core cable shall be made from non-ferrous metal. The contractor shall guarantee (test certificate shall be supplied to prove) that the air clearances and the creep age path on the bushing connecting to the associated switchgear or transformers shall be such that the

completed installation shall withstand in air the impulse and power frequency voltages appropriate to the plant. The cable box clearances would meet the requirements for BS 6435 for partially insulated cable boxes. An earthing terminal shall be provided in each sealing end chamber to which the connections from the transformer winding can be earthed during cable testing. Cable boxes shall be provided on 33kV/11kV sides suitable for air insulations terminations of XLPE Copper Conductor cables of minimum sizes as mentioned below:

31. TEMPERATURE AND ALARM DEVICES

31.1 Temperature Indicating Devices and Alarms

The transformers shall be provided with approved devices of Kilhstrom for indicating the top oil temperature and hottest spot winding temperatures. The devices shall have a dial type indicator and, in addition, a pointer to register the highest temperature reached. Each winding temperature device shall have four separate contacts fitted, two of which shall be used to control the two groups of cooling plant motors (i.e. AF1 and AF2), one to give an alarm and one to trip the associated circuit breakers. The Temperature indicating device shall be from MR Germany or equivalent European class.

To simulate indication of the hottest spot temperature of the winding the device shall comprise a current transformer associated with one phase only and a heating device designed to operate continuously at 130 percent of transformer CMR current and for 30 minutes at 150 percent of CMR current, associated with a sensing bulb installed in an oil tight pocket in the transformer top oil.

The winding temperature indicators (WTI) shall be housed in the marshalling cubicle. The tripping contacts of the winding temperature indicators shall be adjustable to close between 80°C and 150°C and to re-open when the temperature has fallen by not more than 10°C.

The alarm contacts and the contacts used to control the cooling plant motors on the above devices shall be adjustable to close between 50°C and 100°C and to re-open when the temperature has fallen by a desired amount between 10°C and 15°C.

All contacts shall be adjustable to a scale and must be accessible on removal of the relay cover. Alarm and trip circuit contacts shall be suitable for making or breaking 150 VA between the limits of 30 volts and 250 volts AC or DC and of making 500 VA between the limits of 110 and 250V DC. Cooler motor control contacts shall be suitable for operating the cooler contractors direct or, if necessary, through an interposing relay.

The temperature indicators in the marshalling kiosk shall be so designed that it is possible to move the pointers by hand for the purpose of checking the operation of the contacts and associated equipment. The working parts of the instrument shall be made visible by the provision of cut-away dials and glass-fronted covers and all setting and error adjustment devices shall be easily accessible.

Connections shall be brought from the device to terminal boards placed inside the marshalling cubicle.

Terminals, links and a 63mm moving iron ammeter shall be provided in the marshalling kiosk for each WTI for:

- a) Checking the output of the current transformer.
- b) Testing the current transformer and thermal image characteristics.
- c) Disconnecting the bulb heaters from the current transformer secondary circuit to enable the instrument to be used as an oil temperature indicator. Links shall be provided as shown on the drawing enclosed with the offer.

31.2 Gas and Oil-Actuated Relays (Buchholz Relays)

Each transformer shall be fitted with gas and oil-actuated relay equipment having alarm contacts which close on collection of gas or low oil level, and tripping contacts which close following oil surge conditions. The Relay shall be from MR, Germany or equivalent European class.

Each gas and oil-actuated relay shall be provided with a test cock to take a flexible pipe connection for checking the operation of the relay by inserting air in the relay. The floats of the Buchholz shall be solid body. Each relay shall be fitted with UV protective covered glass window for indication of gas volume.

To allow gas to be collected at ground level, a small bore pipe shall be connected to the gas release cock of the gas and oil-actuated relay and brought down to a point approximately 1400mm above ground level, where it shall be terminated by a cock which shall have provision for locking to prevent unauthorized operation.

The design of the relay mounting arrangements, the associated pipe work and the cooling plant shall be such that multi operation of the relay will not take place under normal service conditions, including starting or stopping of oil circulating pumps, whether by manual or automatic control under all operating temperatures.

The pipe work shall be so arranged that all gas arising from the transformer will pass into the gas and oil-actuated relay. The oil circuit through the relay must not form a delivery path in parallel with any circulating oil pipe, nor is it to be fed into or connected through the pressure relief vent. Sharp bends in the pipe work shall be avoided.

When a transformer is provided with two conservators, the gas and oil-actuated relays shall be arranged as follows:

- a) If the two conservators are connected to the transformer by a common oil pipe, one relay shall be installed in the common pipe.
- b) If the two conservators are piped separately to the transformer, two relays shall be installed, one in each pipe connection.

The clearance between oil pipe work and live metal shall be not less than the minimum clearances stated in the schedule of requirement.

32. TRANSFORMER OIL

Insulating oil shall comply with the requirements of IEC 60296. Insulating oil shall be provided by the Contractor for all oil-filled apparatus and 10% excess shall be provided for topping up purposes in sealed drums. The Contractor shall satisfy himself that suitable oil treatment facilities are available at Site for his use. If the Contractor is unable to obtain written assurances to this effect he shall provide such oil treatment facilities as required to meet the specification, at no additional cost.

The Contractor shall supply the first filling of all insulating oil required for the operation of the Plant and, after treatment, a test shall be made in the Engineer's presence to prove that the breakdown voltage is at least 60kV at 2.5mm electrode gap.

Transformer Oil	
Application	Insulating mineral oil for Transformer
Grade of oil	Class-1
a) Physical Properties	
Appearance	Liquid and free from suspended matter or sediment
Density at 20°C	0.895g/cm ³ (maximum)
Flash point (Closed cup)	140°C (minimum)
Kinematics Viscosity at 40°C	12 mm ² /S. (Maximum)
Pour point	-30°C (maximum)
b) Electrical Properties	
Dielectric Strength at 50 Hz (with 2.5 mm standard gap and 40 mm standard depth)	On new untreated oil, the break down voltage shall be >60KV.
Loss tangent/ Dielectric dissipation factor at temp 90°C, stress 500V/ mm to 1000 v/ mm and frequency 40 Hz to 62 Hz.	0.005 (maximum)
c) Chemical Properties	

Acidity	0.01 mg KOH/g (maximum)
Neutralization value after oxidation	0.40mg KOH/g (maximum)
Total sludge after oxidation	0.10% weight (maximum)
PCB Content	Free from PCB
d) Standards	Performance, testing and any other parameter of oil shall comply with the latest revision of the relevant standards BS 148; 1972 IEC – 60296 or latest revision there on.

33. SURGE ARRESTERS (Station Class):

Required numbers of 33 KV & 11 KV Station Class Surge Arresters shall be provided along with each transformer. The transformers will have mounting facilities for required 33 KV & 11 KV surge arresters.

Surge arresters shall be of the type employing non-linear metal oxide resistors without spark gaps. The contractor shall demonstrate by calculations that the surge arresters will adequately protect the switchgear arrangement.

Surge arresters shall be housed in porcelain insulators designed to withstand extremes of the environment described. The insulation shall have a minimum creepage distance of 25mm/kV rated system phase to phase voltage. Porcelain shall comply with IEC 60233. The method of sealing against the ingress of moisture shall be of a type well proven in service and the manufacturing procedures shall include an effective leak test which can be demonstrated to the inspecting engineer if required. The MCOV of the arresters are given below. MCOV exceeding the given range will not be acceptable.

Arrester according to Voltage class	MCOV range (KV)
10 KV	8kV- 10kV
30 KV	22kV – 27.5kV

The internal components of arresters shall be arranged to minimize radial voltage stresses, internal corona and to ensure minimal capacitive coupling with any conducting layer of pollutant on the outside of the porcelain housing.

Good electrical contact shall be maintained between resistor blocks taking account of any thermal expansion and contraction of the block or mechanical shock during transport and erection, by installing a well proven clamping system.

Metal oxide arresters installed outdoors shall be able to dissipate, when new, twice the energy generated in the resistor blocks when energized at their maximum continuous operating voltage immediately having been subjected to the discharge duties specified in IEC 60099-4 and assuming

that the porcelain housing and the surrounding air is at least 5 degree centigrade higher than the maximum ambient air temperature specified.

All surge arresters shall be fitted with a pressure relief diaphragm which shall prevent explosive shattering of the porcelain housing in the event of an arrester failure and the arrester shall have been tested according to the high and low current tests specified in

IEC 60099-1. Arresters shall be supplied complete for installation in an outdoor switchyard, including insulating bases and surge counters, one per phase, and, if applicable, grading rings. The material used for terminals shall be compatible with that of the conductors to which they are to be connected.

Each arrester shall be identified by a rating plate in accordance with the requirements of IEC 60099-4. In addition an identification mark shall be permanently inscribed on each separately housed unit of a multi-unit arrester so that units can be replaced in the correct position in the event of them being dismantled.

Surge counters shall have an internal assembly which is matched to the line discharge capability of the arrester and shall include a leakage current meter with a bi-linear scale for ease of reading. Auxiliary contacts are to be provided to signal remote indication of counter operation.

Surge arrester shall have suitable earth terminal to connect surge counter with insulated cable.

33.1 Tests

Routine tests and type tests shall be carried out to the specified standards. Bidder shall submit type and routine tests reports of surge arresters along with bid proposal.

The following routine tests shall be carried out on all arrester units in accordance with clause 8.1 of IEC 60099-4.

- Measurement of reference voltage
- Residual voltage test
- Partial discharge test
- Housing leakage test
- Current distribution test for multi-column arrester

34. LOSSES AND EVALUTION OF LOSSES

Guaranteed values for component losses of the total loss which shall be as low as is consistent with transport restrictions, reliability and economic use of materials, shall be as stated in the Schedule of Particulars and Guarantees.

For purpose of arriving at comparable prices the iron, copper shall be capitalized on formula given below:

$$A = B + 6384 C + 1915 D$$

Where A = Evaluated present worth value in US Dollars

B = Total bid CIF quoted price in US Dollars

C = Guaranteed Iron Loss in kW

D = ONAN Guaranteed Copper Loss at 75°C

The acceptance of transformers yielding component losses higher than the guaranteed values shall be governed by- IEC 76 part 1. For actual tested losses higher than guaranteed figures but within acceptable tolerance limits, the bidder will be penalized as follows:

- USD 6.384 per watt of increased amount of No-load Loss

- USD 1.915 per watt of increased amount of Load Loss

34.1 Losses:

The maximum acceptable losses at 75 deg. C and at rated voltage, full site rated load and principal tap shall be as stipulated in the following table. Tenderers quoting for transformers with losses exceeding the following figures shall not be evaluated.

Transformer Rating ONAN	Losses in kW	
	No Load Loss (Iron Loss)	Load Loss (Copper Loss)
20 MVA	≤12	≤80

NOTE: 1 The no-load offered losses of a transformer shall not exceed the internationally recognized independent laboratory test value by more than 10 % and the total offered losses of a transformer shall not exceed the independent laboratory test value by more than 6%. It is noted that no-load and full-load losses offered by the supplier shall not exceed the losses specified by BREB (mentioned in the clause 34.1 in the specification.)

NOTE-2: Guaranteed loss values must be supported by test reports from internationally recognized independent testing laboratory. In case of difference between the loss value declared in the offer and the loss value to be found in the type test report, the higher loss value will be taken into account for the purpose of loss capitalization.

34.2 Rejection.

The purchaser may reject any transformer, if during evaluation and testing the following is found:

- Load and/or no-load losses exceed the guaranteed value by 15% .
- Total losses exceed the guaranteed values by 10% .
- Impedance differs from the values as specified in clause 16.
- Transformer fails any test.

The Supplier shall supply the replacement transformer and clause 5 shall apply for acceptance of the same.

35. FOR OLTC Type 20/28 MVA 33/11.55 KV (ONAN/ONAF) TRANSFORMER

- 20/28 MVA ONAN/ONAF indoor/outdoor mounting, 3-phase, 50 Hz, Dyn1, uniform insulation, 33 kV +4×1.5% and -12×1.5% (HV taps on-load operating), mineral oil immersed, equipped with BCT. The supply of transformer will also include suitable size of MS rail for placing of transformer on foundation.
- | | | | |
|--------------------------------------|----|----|----|
| Normal System Voltage between Phases | KV | 33 | 11 |
| System Frequency | Hz | 50 | 50 |

Rated Voltage between Phase	KV	36	12
Lightning Impulse withstand	KV	170	75
50 Hz withstand, 1 minute	KV	70	28
Symmetrical Short Circuit Current (3sec.)	KA	31.5	31.5

- c) The three H.T bushing shall be porcelain type being brown glazed. The BCT fitted in the neck of each bushing shall be 20 VA, 600/5A, Class: 5P20
- d) The three L.T bushings, one for each phase and one bushing for the neutral may be of capacitor type or porcelain type with outside glazed of brown porcelain. The BCT fitted in the neck on each phase bushings shall be 20 VA, 1800/5 A, Class: 5P20 and that on the neutral bushing shall be 20 VA, 1800/5 A, Class: 5P20. In addition to that the "b" phase bushing of the LT side should have a BCT having ratio 1800/5A, 20VA, 0.2 (for WTI), in "a" phase bushing of the LT side should have another BCT having ratio 1800/5A, 20 VA, accuracy class .2(Metering CT FS < 5) (for OLTC by auto voltage regulating relay) and in neutral phase bushing should have another BCT having ratio 1800/5A, 20 VA, 5P20 (for Stand by Earth Fault)."
- e) The winding shall be of electrolytic copper, free from burs and splinter. Paper shall be used for conductor insulation. The manufacturer must provide the thermal damage curve or thermal damage description of the transformer winding or the transformer as per relevant IEC standard
- f) The insulating oil shall meet all requirements as defined by NEMA standard/BS shall be chemically stable, free from acidity and other corrosive ingredients and shall possess high dielectric strength oil for first filling shall be shipped in non-returnable drums. 10% of the quantity required for a transformer is to be supplied in addition in respect of each transformer due to usual losses during installation, centrifuging, etc.
- g) The transformer tank shall be of welded construction, fabricated from high tensile steel plate and shall be designed so that the tank is to withstand vacuum up to 500mm of mercury for 20 MVA transformers and any pressure of oil developed during operation conditions including short circuits.
- h) The transformer shall have air seal conventional type oil conservator tank (the oil surface is completely isolated from the atmosphere by installing an oil resistant rubber seal in the interior of the conservator) at the top divided into two halves internally: one part to be connected with transformer main tank through Buchholz Relay (with cocks on both side) and the other part with OLTC tank through another gas Relay (with cock either side). Both the halves will have oil level indicator (visual) with contacts for indication "LOW OIL LEVEL" in the control panel.
- i) Pressure Release Devices for both main tank and OLTC Tank shall be provided.
- j) Silica Gel Breather with glass window shall be provided for both halves of the conservator tank.

- k) The on-load Tap Changer operating device shall be equipped with local (manual and electrical) and remote electrical operating device with appropriate interlocking. The OLTC motor shall be 3-phase 400 V operating type. The mechanical position indication shall be there both at the tap changer as well as on the operating device. Contacts/Arrangements shall be there for remote position indication (by lamp glowing) of the tap. Appropriate glands for the entry of control cable shall be provided.
- l) Sufficient cooling Fans (3-phase, 415V, 50 Hz) of adequate capacity shall be fitted on the body of the transformer for cooling purpose to achieve the ONAF rating over the average ambient temperature of 40 degree C. There shall be a control device in weather proof housing fitted on the body of the transformer and equipped with control relay operated by sensing device of oil temperature inside the transformer and operate requisite no. of fans. Besides there shall be manual switching device of cooling fans.
- m) The Radiators shall be in banks which can be fitted with or removed from the body of transformer tank. Sufficient radiators shall be provided to achieve the ONAN rating at average ambient temperature of 40 degree C. Each bank of radiator must have two stop valve one of which should be fixed at the top and the other at the bottom.
- n) Besides the main components of the transformer the other features and accessories to be associated which are as follows:
 - i) Inspection hole with cover.
 - ii) Manhole.
 - iii) Name plate with complete diagrams and main specifications.
 - iv) Upper and lower oil valves, oil sampling valve and drain valve.
 - v) Ladder to climb up to top with barrier at the bottom.
 - vi) Thermometer for sensing oil and winding temperature and display.
 - vii) All HV (33 KV) terminals shall be provided with appropriate connecting clamps to be connected with 400 mm² cables. The LV (11 KV) terminals shall have also connecting clamps appropriate for being connected with on 4×300 mm² cables. The neutral terminal shall have connecting clamps to be connected with 2/0 HDBS wire.
 - viii) There shall be four wheels (flanged type) suitable for mounting on rails and to carry the transformer as a whole.
 - ix) The transformer shall have at least two grounding terminals on its body.

All ferrous parts of the transformer shall be galvanized or painted with appropriate paints of MUNSELL NO-5y 7/1 transformer with maximum shipping height (not exceeding 11 feet) will be preferred.

- o) One set of extra gaskets for each transformer is to be supplied with the transformer lot without extra cost.

36. WARRANTY

The bidder shall warrant that the transformers furnished have conformed to this specification. The warranty shall state that if, within three (3) years from the date of

commissioning, a transformer is found to have defects in workmanship or material or fails in service , the Contractor shall repair or replace such defective parts (and other parts damaged as a result) within 15 days with free of charge .

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For OLTC Type 20/28 MVA 33/11.55 K, 50 Hz TRANSFORMERS

(To be filled up by the supplier with appropriate data, otherwise the Tender will be rejected)

Description	Unit	REB Requirement	Tenderers Guaranteed Values
33/11.55 kV TRANSFORMERS			
1. Manufacturer's Name			
2. Manufacturer's Address			
3. Applied Standard			
4. Type		Outdoor Oil immersed	
5. Rated Power	MVA	ONAN/ONAF 20/28 MVA	
6. Number of Phase		Three Phase	
7. Rated Voltage, Phase to Phase			
High Voltage winding	kV	33	
Low Voltage winding	kV	11.55	
8. Rated frequency	Hz	50	
9. Rated insulation level			
(a) Impulse withstand, full wave			
High voltage winding	kV	170	
Low voltage winding	kV	75	
Neutral side		Full insulation	
(b) AC withstand voltage			
High voltage winding	kV	70	
Low voltage winding	kV	28	
10. Vector Diagram (IEC 76-4)		Dyn1	
11. Type of Cooling, 20/28 MVA		ONAN/ONAF	
12. On load Tap- changer ('MR' Germany/ABB, Sweden/ Hitachi Energy, Sweden)			
Type		Required	
Rated tap	kV	33	
Tap range	%	+ 6 to -18	
Capacity	Amps	Required	
Numbers of tap	Taps	17 Nos	
Tap Step	%	1.5	
Location of tap		Primary side	
Rated short time current	kA	Required	
Oil volume	Liter	Required	
Duration of one step change	sec	Required	
Motor rating	kW	Required	
13. Impedance voltage at 75°C and at nominal ratio and 100% rated power at principal tap			
(a) 20 MVA	%	10.0% (with +10%	

Description	Unit	REB Requirement	Tenderers Guaranteed Values
		tolerance)	
14. Temperature rise at rated power (Max. ambient temperature: 40°C)			
Oil by thermometer	deg. C.	55	
Winding by resistance measurement.	deg. C.	60	
14a. Winding hot spot temperature on emergency overload not to exceed	Deg. C	140	
14b. Maximum hot spot temperature when loaded in accordance with IEC 354	Deg. C	118	
15. System symmetrical fault level at terminal of			
33 kV	kA	31.5	
11 kV	kA	31.5	
15a. Duration of symmetrical short circuit current for which the transformer is to be designed (calculation as per IEC is to be furnished)	Sec	2	
16. Transformer core			
Type of core flux density			
At nominal voltage	Tesla	≤1.6	
17. Transformer bushings shall be from Europe/America/Japan origin			
(a) H.V. Bushing			
Voltage class		Required	
Cantilever strength		Required	
(b) L.V. Bushing			
Voltage class		Required	
Cantilever strength		Required	
(c) Neutral Bushing			
Voltage class		Required	
Cantilever strength		Required	
18. Conservator		Required	
19. Auxiliary circuit voltage for fan, etc, 3P-4W	V	415/240 AC	
20. Control Voltage	V	110 DC	
21. Sound level (IEC 551)			
ONAN (0.3m)	dB	65	
ONAF (2m)	dB	80	
22. Transformer Bushing CT			
<u>HV Side</u>			
On phase "a, b &c" (Differential)			
- Current Ratio	A	600/5	
- Rated burden	VA	20	
- Accuracy		Class X	

Description	Unit	REB Requirement	Tenderers Guaranteed Values
- Short time current	kA		
<u>LV side</u>			
On phase "a, b &c" (Differential)			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class X	
- Short time current	kA		
On phase "a" (OLTC)			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 5P20	
- Short time current	kA		
On phase "b" (WTI)			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 0.2	
- Short time current	kA		
Neutral Bushing for REF:			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class X	
- Short time current	kA		
Neutral Bushing CT for stand by earth fault			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 5P20	
- Short time current	kA		
23. Number of Cooling fan	Nos.		
24. Rating of Fan motors	kW		
25. Cooling fan losses at full ONAF capacity operation	kW		
26. Core Loss at rated frequency and rated voltage at nominal tap.	kW		
27. Copper Loss at full load, at rated frequency and 75 °C			
(i) At ONAN			
(a) At Maximum Tap	kW		
(b) At Nominal Tap	kW		
(c) At Minimum Tap	kW		
At ONAF			
(a) At Maximum Tap	kW		
(b) At Nominal Tap	kW		
(c) At Minimum Tap	kW		
28. Exciting Current at nominal tap and rated voltage	A		

Description	Unit	REB Requirement	Tenderers Guaranteed Values
29. Dimensions and Weight			
Maximum size for transport			
L x W x H	mm		
Heaviest weight for transport	Kg		
Overall height	mm		
Oil volume	Liter		
Weight of oil	Kg		
Weight of core	Kg		
Total weight	Kg		
30. Oil level indicator			
Type and model			
31. Pressure Relief Device			
Type and model			
32. Buchholz Relay			
Type and model			
Float Type		Solid Body	
Petcock is provided for testing by injecting air		Yes	
Pipe arrangement for gas release and oil collection from ground level		Yes	
Oil surge protection		Yes	
Oil drain screw provided		Yes	
33. Oil & Winding temperature indicator			
Type & model			
34. Efficiency at 75° C at unity power factor:			
a) At 28 MVA load	%		
b) At 20 MVA load	%		
c) At 15 MVA load	%		
d) At 10 MVA load	%		
35. Transformer tank	Shall be provided	Shall be high tensile steel plate	
36 .Pressure release device for both main and OLTC Tank	Shall be provided	Shall be provided	
37. Winding shall be of electrolytic copper.	Shall be provided	Shall be Electrolytic copper	
38. Pressure release device, Temperature indicating device and Buchholz relay shall be from MR Germany or Equivalent European Origin.	To be provided	Shall be from MR Germany or Equivalent European Origin.	

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
33 kV SURGE ARRESTER, Station Class

(Failure to provide all of the information requested may lead to the rejection of the bid.)

SI No	Description	Unit	REB Requirement	Tenderer's Guaranteed Values
33 KV SURGE ARRESTER				
1.	Manufacturer's Name & Address		Required	
2.	Class of diverter to IEC 99-4		Heavy duty, ZnO	
3.	Rated voltage (RMS)	kV	30	
4.	Rated current	kA	10	
5.	Neutral connection		Effectively earthed	
6.	Power frequency withstand voltage of housing:			
	Dry :	kV	70 (RMS)	
	Impulse:	kV	170	
7.	Lighting impulse residual voltage	kV	100 peak	
8.	Steep current impulse residual voltage at 10 kA or 1 μ S front time	kV	110	
9.	Pressure relief device fitted?	Y/N	Required	
10.	Leakage current at rated voltage	A	Required	
11.	Minimum reset voltage	V	Required	
12.	Total creepage distance	mm	Required	
13.	Surge monitor		Required	
14.	Connecting Lead from LA terminal to surge monitor:		Shall be Insulated 16 mm ² copper cable	
15.	Overall dimension and Weight:			
	Height	mm	Required	
	Diameter	mm	Required	
	Total weight of arrester	Kg.	Required	
	Height	mm	Required	
16.	Housing material		Porcelain	
17.	MCOV	kV	22-27.5	

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
11 kV SURGE ARRESTER, Station Class

(Failure to provide all of the information requested may lead to the rejection of the bid.)

SI No	Description	Unit	REB Requirement	Tenderer's Guaranteed Values
11 kV SURGE ARRESTER				
1.	Manufacturer's Name & Address		Required	
2.	Class of diverter to IEC 99-4		Heavy duty, ZnO	
3.	Rated voltage (RMS)	kV	10	
4.	Rated current	kA	10	
5.	Neutral connection		Effectively earthed	
6.	Power frequency withstand voltage of housing:		Required	
	Dry :	kV	28(RMS)	
	Impulse:	kV	70	
7.	Lighting impulse residual voltage	kV	Required	
8.	Steep current impulse residual voltage at 10 kA or 1 μ S front time	kV	Required	
9.	Pressure relief device fitted?	Y/N	Required	
10.	Leakage current at rated voltage	A	Required	
11.	Minimum reset voltage	V	Required	
12.	Total creepage distance	mm	Required	
13.	Surge monitor		To be provided	
14.	Connecting Lead from LA terminal to surge monitor:		Shall be Insulated 16 mm ² copper cable	
15.	Overall dimension and Weight :			
	Height	mm	Required	
	Diameter	mm	Required	
	Total weight of arrester	Kg.	Required	
	Height	mm	Required	
16.	Housing material		Porcelain	
17.	MCOV	kV	8-10	

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
33/0.415 kV, 3 Phase 100 KVA STATION TRANSFORMER
(Failure to provide all of the information requested may lead to the rejection of the bid.)

Description	Unit	REB Requirement	Tenderer's Guaranteed Values
STATION SERVICE TRANSFORMERS			
1. Manufacturer's Name		Required	
2. Manufacturer's Address		Required	
3. Type		Required	
4. Applicable Standard		Required	
5. Rated power	kVA	100	
6. Rated voltage :			
- High voltage winding	kV	33	
- Low voltage winding	V	415 / 240	
7. Vector diagram		Dyn 11	
8. Rated Frequency	Hz	50	
9. Type of cooling		ONAN	
10. Type of bushing :			
- High voltage		Required	
- Low voltage		Required	
11. Off load tap-changer :			
- Rated tap	kV	33	
- Tap range	%	+ 5 to – 5	
- Number of taps	Taps	5	
12. Impedance voltage at 75deg C., at nominal ratio and rated power	%	4%±10%	
Temperature rise at rated power		Required	
(Max. ambient temp.: 40° C)		Required	
13. - Oil by thermometer	deg. C	55	
14. Winding by resistance measurement	deg. C	60	
15. Dimensions and Total Weight		Required	
16. Height x width x depth	mm	Required	
17. Total weight	Kg	Required	

Description	Unit	REB Requirement	Tenderer's Guaranteed Values
18. Dimensions and Total Weight		Required	
19. Core Loss at rated frequency and rated voltage at nominal tap.	kW	Required	
20. Copper Loss at full load, at rated frequency and at 75 °C			
(a) At Maximum Tap	kW	Required	
(b) At Nominal Tap	kW	Required	
(c) At Minimum Tap	kW	Required	

BANGLADESH RURAL ELECTRIFICATION BOARD (BREB)
PEOPLES REPUBLIC OF BANGLADESH
STANDARD FOR

TECHNICAL SPECIFICATION FOR 33KV OUTDOOR TYPE VACUUM CIRCUIT BREAKER WITH CONTROL PANEL

1. SCOPE:

- 1.1 This Specifications intended to cover the design, manufacture, assembly and Testing at manufacturer's works of 33 KV, 3 Ph, 50 Hz, 1250A, 31.5 KA 3s, Outdoor Type Porcelain Clad, Vacuum Circuit Breaker for efficient and trouble-free operation as specified hereunder.
- 1.2 The Circuit Breakers are required complete with structures, operating mechanism and all associated accessories and auxiliaries.

2. STANDARDS:

The Equipment to be furnished under this Specification, shall be designed, constructed and tested in accordance with the latest revisions of relevant International Electric-Technical Commission (IEC 56/IEC-62271-100). The Equipment conforming to any other national Technical standards which ensure equivalent quality are acceptable.

Instructions to Bidders: In such cases the Bidders shall clearly indicate the standard adopted and should furnish a copy of the English translation of the standard along with the bid.

International Electric-Technical Commission Standards of 60044-1 for CT and 60044-2 for PT and Insulators and other devices, accessories etc. shall be followed relevant IEC standard.

3. GENERAL INFORMATION:

- 3.1 The Circuit Breakers specified herein are to be normally installed anywhere in Bangladesh at an altitude not exceeding 1000 meters above mean sea level. For higher altitude beyond 1000 meters adequate creep age distance, pole to pole distance etc. shall be designed and offered.
- 3.2 The general Weather Conditions are stated below.
- | | |
|---------------------------------|---|
| i) Climate condition | : The area is Tropical with monsoon from June to October, about 3000 mm annual rain fall. |
| ii) Number of Thunderstorm days | : 80 days/year. |
| iii) Ambient Temp | : 45 ⁰ C (max) and 4 ⁰ C (min). |
| iv) Maximum Wind Pressure | : 150 Kg. Mtr. Sq. |

- 3.3 The Equipment offered shall be suitable for heavily polluted atmosphere.
- 3.4 The Equipment to be furnished under this Specification shall be packed for shipment so as to meet the weight and space limitations of transport facilities, specifically along with Rail, Road, right of way.
- 3.5 The Equipment covered by this Specification shall be complete in all respects. Any material or accessory which may not have been specifically mentioned, but is essential or necessary for satisfactory and trouble free operation and maintenance of the Equipment shall be furnished without any extra charge to the Employer.
- 3.6 The Equipment shall be supplied with all accessories listed in this Specification with such modifications and alternations as to safeguard the Technical requirements.

4. DESIGN CRITERIA:

- 4.1 The Equipment will be used in effectively neutral grounded System with fault level of 31.5 KA at highest system voltage of 36 KV.
- 4.2 Continuous current rating shall be 1250 Amp. Maximum temperature attained by any part of the Equipment at specified rating should not exceed the permissible limit as stipulate in the relevant standards. Equipment shall be designed taking 500C as maximum ambient temperature.
- 4.3 The circuit breakers and their components shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current of the system without any damage or deterioration of material.
- 4.4 The circuit breakers shall have motor wound spring charged trip free mechanism with anti-pumping feature, and shunt trip. In addition, facility for manual charging of spring shall be provided.
- 4.5 Each breaker shall be provided with manual close & open facility, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.
- 4.6 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. A visual mechanical indicating device will also be provided to show the position of the spring.
- 4.7 All controls shall be suitable for 80%, to 110% for closing & 70% to 110% for tripping of 110V D.C. The A.C. supply shall be available 415/230 Volt, 50 Hz.
- 4.8 The operating duty of the Breaker will be 0-0.3 sec-CO-3 min-CO.
- 4.9 There shall be no radio interference when the Equipment is operated up to maximum service voltage.
- 4.10 The minimum safe clearance of all live parts of the Equipment shall be as per relevant standards. Clearances of 33 KV Low Level pipe bus of switchyard are:

- a) Phase to Phase : 1200 mm and
- b) Pipe bus to ground level of supporting structure : 4000 mm

- 4.11 All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the Breaker shall be furnished. The interlocking device shall be of proven quality.
- 4.12 The condition of Breaker and its contacts shall be intact even under conditions of phase opposition that may arise due to faulty synchronization or otherwise. Bidders should confirm in this regards.
- 4.13 The Breaker shall be capable of smooth and rapid interruption of current under all conditions, completely suppressing the undesirable phenomenon even under the most severe and persistent rated short circuit conditions. There will be no abnormal voltage rise subsequent to the switching ON/OFF a capacitor bank within the rated capacity.
- 4.14 The total make and break time (in m sec/cycle) for the breaker throughout the range of their operating duty shall be indicated and guaranteed.
- 4.15 The breaker shall be suitable for interrupting low inductive currents without generation of abnormal over voltage.
- 4.16 The breaker shall be capable of interrupting rated breaking current with recovery voltage equal to maximum line Service Voltage and at all inductive power factor of the Circuit equal to or exceeding 0.15.
- 4.17 The Circuit Breaker shall be capable to withstand power frequency over Voltage 70 KV for 1 min.
- 4.18 Instructions to Bidders: The Bidder may indicate in his offer the methods adopted for limiting over voltage.
- 4.19 The Circuit Breaker with its hot dip galvanized steel structure shall be suitable for mounting on concrete foundation. The height of the supporting structure will be such that it will be able to maintain clearance as indicated in clause 4.10 above.
- 4.20 The detail of steel structure, foundation design and erection drawing shall be given. In GA/Structure drawing please indicate the location of CB point of application of dynamic load and its amplitude, dead load etc.
- 4.21 Special tools & tackles required for erection and dismantling and fitting of the Breaker and its accessories, if required shall be offered indicating the prices etc.

5. CONSTRUCTION:

Each vacuum Circuit breaker shall comprise of three identical poles linked together electrically and mechanically for synchronous operation.

Vacuum Interrupter

The vacuum interrupter, consisting of fixed contact and moving contact, shall be interchangeable among the same type interrupter. Short circuit capacity of vacuum bottle should be 31.5 KA and design life should be 100 nos. Operation at rated short circuit level. The operation of the interrupter will be 30000 nos. at rated current.

- i) Instructions to Bidders: Constructional features of the vacuum chamber along with its functional arrangements are to be shown in a drawing submitted along with bid documents.
- ii) The gap between contacts of the Circuit Breaker inside interrupter should be capable of withstanding 1.3 time voltage to neutral at one atmospheric pressure at normal ambient condition within Breaker in the event of vacuum pressure drop due to leakage.
- iii) Vacuum Bottle shall be of Siemens/ABB or/ALSTOM and of reputed indigenous make. Offered bottle shall be identical with Type tested one. Brochures/leaflet on technical data sheet for vacuum bottle shall be enclosed with technical bid.

Control Panel and Protective Relays

- i) Protective relays must be provided by the Contractor with the breaker. The relays must be numerical relays (from ABB, Sweden/Switzerland/Finland or Siemens, Germany or GE, USA/UK) for over current, earth fault protection and differential of 33kV feeder. There must be one master trip relay for inter tripping.
- ii) All the relays should be 61850 protocol type for automation network of the 33/11.55 kV Sub-station.
- iii) Plug setting range will be from 5% to 2000% and time setting range from 2.5% to 1500%.
- iv) All indicating instruments shall be switch board type connected suitable for flush mounting and provided with dust and vermin proof cases for tropical use and finished in suitable color. All instrument have practical lab. means of adjustment of accuracy. The limit error of voltmeter and ammeter shall be permissible for 0.2 instrument
- v) There must have minimum 3 nos. Ammeter, 1 nos. voltmeter, 1 nos MFM and 1 nos voltmeter selector switch, Test terminal block, ON/OFF/Auto Trip/Spring Charge etc. indication lamps of different colors. All indication meters will be Digital.

6.1 MAIN CONTACTS:

- a) In vacuum interrupter the contact configuration, contact area, contact pressure will be sufficient for carrying rated current and short time rates current, without any abnormal phenomena.
- b) Complete details of main contacts shall be furnished. The material of contacts and coating of the contacts shall be suitable for vacuum Breaker technology. Evaporation of metal during arcing and deposition of the same in the inner surface of vacuum interrupter should be restricted by adopting suitable material. Bidder shall furnish the justification of using the materials for contacts.

- c) Complete details of main contacts and arc quenching device, if any with sectional drawings shall be furnished at the time of offer. Measures taken to free the contacts from vibration during closing shall be clearly explained in the drawing, support by tests results.
 - d) The contact erosion should be limited up to 3 mm for useful life and indication to monitor the progress of contact erosion has to be provided.
- 6.2 The vacuum pressure within interrupter shall be adequate to interrupt the fault current. Precaution shall be taken so that there will be no flush over on outside of the vacuum interrupter inside the porcelain insulator.
- 6.3 Design of the vacuum bottle and its insulator encasing should be suitable for outdoor use, taking care of required creepage distance considering possibility of moisture condensation if any, in the annular space between the vacuum bottle and insulator enclosure. Type test with identical bottle type with similar encasing arrangement shall be done and accordingly Report shall be submitted along with bid document.
- 6.4 Vacuum bottle with its insulator encasing chamber shall be hermetically sealed. Free passage of air in the chamber with or without provision of circulation of hot air is not accepted.
- 6.5 Tripping/Closing Coil burden of Equipment should not be more than 200 watts at 110 V D.C. The value will not be relaxed, especially for tripping coil.

6.5 OPERATING MECHANISM:

- a) The operating mechanism shall be suitable for rapid closing and tripping. The opening and closing energy shall be obtained from spring charge mechanism. The spring charging may be done by either motor operation with facility for manual charging when required or by other suitable trouble free mechanism. Local arrangement for operating breakers both electrically and mechanically shall be provided in addition to remote operation.
- b) The mechanism shall have anti-pumping circuitry and will be trip free electrically and mechanically. The anti-pumping arrangement shall be initiated through normally „NO“ type, direct auxiliary contact of circuit breaker and shall be of self-hold type. Plug-in type relay/Contactor for Anti-pumping Relay will not be acceptable.
- c) Spring operated mechanism will be complete with opening spring, closing spring, limit switch and all necessary accessories to make the mechanism a complete operating unit.
- d) Contactor used for anti-pumping relay shall be of reputed make.

- e) There shall be mechanical ON/OFF indicator spring charge and operation counter for each Breaker and also provision for remote indication.
- f) The operating mechanism box shall be fixed at a working height from ground level. View glass shall be provided on hinged door at the front side.
- g) Spring charging LS shall have sufficient no. of spare contact.

6.6 COMMON CONTROL CUBICLE:

- a) A free standing outdoor type weather proof, dust and vermin proof cubicle shall be provided to house the operating mechanism and all other accessories except those which must be located in the pole box.
- b) The cubicle shall be of 3.00 mm thick sheet steel and shall have hinged doors at front and hinged/bolted door or cover at rear for access to the mechanism. Doors should be of proper design for smooth opening and closing with pad locking arrangement.
- c) A removable gland plate of 3 mm thickness shall be provided at the bottom of the cubicles for the Employer's Cable entry. Glands of sizes suitable for entry of 1 no. 12 core, 2 nos. 8 core and 2 nos. 4 core Cables for Control etc.
- d) Terminal blocks for AC & DC shall be kept separate. Terminals shall be suitable for at least 2X 2.5 sq.mm copper leads. All wiring shall be of 1100 V grade PVC.
- e) Thermostat controlled heaters shall be provided to prevent condensation within cubicle. Cubicle illumination Lamp with switch and a 230 V, 15A, 3 pin sockets with a Control Switch shall be provided.
- f) All controls, alarms, indications and interlocking devices furnished with breaker shall be wired up to the terminal Black in the common control cubicle. Not more than two wires shall be connected to one terminal.
- g) All wires shall be identified at both ends with ferrule marking in accordance with approved wiring diagram.
- h) Terminal blocks shall have compression type multi-way terminals with bonding screws and washers. At least 15% spare terminal shall be provided.
- i) Scheme diagram on a durable sticker shall be fixed on inside door of Control Cubicle.
- j) Degree of protection of control cubicle shall be IP-55.

7. INSULATORS:

- a) Porcelain supports, interrupter housing of adequate mechanical and dielectric strength with suitable creep age distance shall have to be used. All Support/Interrupter Housing of identical ratings shall be interchangeable. Each Interrupter-Housing shall be provided with terminal stud/pad.
- b) The porcelain used in interrupter housing shall be made from wet process and shall be homogeneous, free from laminations, caustics and other flaws which may impair its mechanical or dielectric strength and shall be glossy, tough and impervious to moisture.
- c) The porcelain supports, interrupter –housing insulation shall be coordinated with that of Circuit Breaker. The puncture strength of the bushings shall be greater than the dry flashover value.
- d) When operating at rated voltage, there shall not be any electrical discharge between live terminal and earth. No Radio disturbance shall be caused by the support insulators when operating up to the maximum System Voltage. It shall also be free from corona.
- e) All iron parts shall be hot dip galvanized. The nuts, bolts, washers etc. shall also be hot dip galvanized steel or stainless steel.
- f) Each Circuit Breaker shall be provided with Bi-metallic terminal stud/pad suitable for connection of pipe bus/ACSR Conductor.

8. AUXILIARY CONTACTS:

- a) Breaker shall be provided with 9 NO & 9 NC spare auxiliary contacts in addition to the auxiliary contacts required for Breaker's own operational requirements. These auxiliary contacts shall preferably be convertible type.
- b) These contacts shall have continuous current rating of at least 10A. The breaking capacity shall be adequate for the circuits controlled, or at least 12A at 110 V DC with a circuit time constant of minimum 20 ms.
- c) All these contacts shall be wired up to terminal block in the control cubicle. Auxiliary contacts which are to be installed on the frame of Circuit Breaker shall be suitably protected against accidental arcing from main circuit. Insulating materials of contacts shall be ceramics or other non-tracking materials.

9. GROUNDING:

Circuit Breaker shall be provided with two grounding pads with 2 nos. tapped holes for M10 bolts and spring washers for connection of the Employer's grounding conductor (50x6 mm G.I. strips).

10. PAINTING:

External surfaces shall be given a coat of high quality red oxide or other suitable primer and shall be finished with two coats of synthetic enamel paints. Such painting should be able to withstand tropical climate as stipulated in Sl.No.3 of this Specification.

11. EQUIPMENT FOUNDATION AND STEEL STRUCTURE:

- a) The Circuit breaker etc. shall be furnished complete with base frame, anchor/foundation bolts and hardware. Details structure assembly drawing, mentioning part no. of each member and also indicating cross sectional area of member used with supporting calculations. The point of C.B. dynamic load and its amplitude, dead load etc. shall be mentioned.
- b) Similar grounding pad as mentioned against Sl.No.8 are also to be provided.
- c) If the Centre line of Control Cubicle is more than 1.50m above ground plate, one suitable platform with checker plate shall be fixed at a suitable height of support structure with ladder step arrangement, to access the control cubicle for Local operation & maintenance purpose.

12. CURRENT TRANSFORMER:

Current transformers, three per circuit breaker, shall be of outdoor, single phase, electromagnetic induction, oil immersed, suitable for operation in hot and humid atmospheric conditions described in service condition. They shall be mounted on the bracket. The CT tank should be Hot Dip galvanized as per relevant IEC to prevent corrosion of all exposed metal parts.

12.1 Core

High grade non-ageing cold rolled grain oriented (CRGO M4 or better grade) silicon steel of low hysteresis loss and permeability shall be used for the core so as to ensure specified accuracy at both normal and over currents. The flux density shall be limited to ensure that there is no saturation during normal service.

The instrument security factor of the core shall be low enough so as not to cause damage to the instruments in the event of maximum short circuit current.

12.2 Winding

The secondary windings shall be made of electrolytic copper with suitable insulation. The conductor shall be of adequate cross-section so as to limit the temperature rise even during short circuit conditions. The insulation of windings and connections shall be free from composition liable to soften coze, shrink or collapse during service.

Polarity shall be indelibly marked on each current transformer and at the lead and termination at associated terminal blocks. CTs with multi ratio winding shall be clearly tabulated to show the connections required for different ration. Similar numbers shall be marked on terminal block arrangement and wiring diagram.

The continuous current rating of the primary winding shall be one hundred and twenty percent of the normal rated current. Secondary windings of current transformers shall be used for metering, instrumentation and protection and shall be rated for continuous current of one hundred and fifty percent of normal rated current of primary winding.

12.3 Construction

The current transformer enclosures shall be made of high quality steel and shall be not dip galvanized and shall be able to withstand and stresses occurring during transportation and the terminal and mechanical stresses resulting from maximum short circuit current in service. The primary winding and terminals shall be in a tank and supported by a hollow porcelain insulator. The secondary connection shall be conducted through the hollow insulator and terminated in a terminal box mounted on the base plate.

12.4 Insulation level

The current transformers shall be designed to withstand impulse test voltages and power frequency test voltage as specification.

13. POTENTIAL TRANSFORMER

The voltage transformer to be supplied under this specification shall be of outdoor, single phase dead tank double wound, oil immersed type for operation in hot and humid atmospheric conditions described in this document. To prevent corrosion of the exposed surfaces, the tank should be not dip galvanized. They shall have separate HV and LV windings and shall be suitable for use as bus VTs in 33 KV.

13.1 Duty requirement

33KV Voltage transformer for all the indicating instruments, measuring meters and protection on the 33 KV side.

13.2 Porcelain Insulator

External parts of the voltage transformers which are under continuous electrical stress shall be of hollow porcelain insulators. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed and shall be suitable for the worst environmental conditions for heavily polluted atmosphere and shall be not less than 25mm per KV of highest phase to phase system voltage with protected creepage distance minimum 50 percent of the total. Internal surfaces of hollow insulators shall also be glazed.

The insulators shall be withstand in high mechanical, tensile and breaking strength. All porcelain used on the voltage transformers shall have the following properties high strength, homogeneity, uniform glaze, free from cavities and other flaws and a high quality uniform finish porcelain components shall withstand the maximum expected static and dynamic loads to which the voltage transformers may be subjected during their service life. The insulation of the hollow porcelain insulators shall be coordinated with that of the voltage transformers to ensure that any flash over occurs only externally.

13.3 Core

High grade non-ageing cold rolled grain oriented silicone steel of low hysteresis loss and permeability shall be used for core so as to ensure accuracy at both normal and or over Voltage. The flux density shall be limited to 1.6 Tesla at normal voltage and frequency. There shall be no saturation at any stage during operation.

The instrument security factor of the core shall be low enough so as to cause damage to the instruments in the event of maximum short circuit current or over voltage.

13.4 Windings

The primary and secondary windings shall be electrolytic copper of high purity and conductivity and covered with double paper insulation. The conductor shall be of adequate cross-section so as to limit the temperature rise even during maximum over voltages.

The insulation of windings and connections shall be free from composition liable to soften, ooze, shrink or collapse during service. The secondary windings of the voltage transformers shall be suitable for continuous over voltage corresponding to the maximum system voltage at the primary winding. The winding supports shall be suitable reinforced to withstand normal handling and the thermal and dynamic stresses during operation without damage. The voltage transformer secondary circuits will be taken out to form the star point and earthed at one point outside the voltage transformers.

Both primary and secondary winding terminals shall be clearly and indelible marked to show polarity. The connections required for different secondary windings in case of multi-winding voltage transformers shall be clearly indicated in terminal blocks and the wiring diagrams.

13.5 Secondary Terminal Box

A dust vermin and weather proof terminal box shall be provided at the lower end of each voltage transformer for terminating the secondary windings. The box shall have a bolted removable cover plate complete with gaskets. The terminal box shall

have cable gland plate and cable glands with shrouds suitable for entry of 4 core $\times 2.5\text{mm}^2$ PVC insulated control cables. The terminal box enclosure shall have protection of class IP 55.

13.6 Circuit diagram

A durable copy of the circuit wiring diagram shall be affixed to the inner side of the terminal box cover. Labels shall be provided inside the cover to describe the functions of various items of equipments.

13.7 Earthing Termination

Two earthing terminals complete with necessary hardware shall be provided on each voltage transformer for connecting to earth continuity conductors of the Employer. They shall be of electroplated brass and of adequate size to carry the earth fault current.

The earthing terminals shall be identified by means of appropriate symbol marked in a legible and indelible manner adjacent to the terminals.

14. DRAWING, MANUALS AND TYPE TEST CERTIFICATES:

The following drawings and manuals shall be furnished for information purpose with each copy of the bid.

- 14.1 General Arrangement Drawings indicating all dimensions,
- 14.2 Technical leaflets/manuals on each piece of Equipment explaining the function of various parts, principle of operation and special features. Technical leaflets/manuals for offered type of vacuum bottle etc.
- 14.3 Type Test Certificates as per IEC carried out on Similar Circuit Breaker from reputed/recognized laboratory shall be furnished with the bid.
- 14.4 Supplier also have to provide test reports of relays.

15. CONTRACT DRAWING AND CATALOGUE:

After placement of order, six (6) copies of various drawings data and manuals as mentioned below shall be submitted to the Project Manager/Employer.

- 15.1 Dimensional General Arrangement drawing showing all dimensions and disposition of fittings and space requirement and mounting arrangements.
- 15.2 Sectional views of contact assembly, operating mechanism and arc extinguishing chamber.
- 15.3 Transport/shipping dimensions with weights.

- 15.4 Foundation and anchor details including dead-load and impact load with direction and also point of application.
- 15.5 Assembly drawing for erection at site with part numbers and schedule of materials.
- 15.6 Electrical schematic and wiring diagram with explanatory notes, if any.
- 15.7 Schematic diagram for spring charged operating mechanism schematic layout drawings.
- 15.8 Name plate drawing and any other relevant drawing and data necessary for erection, operation and maintenance.
- 15.9 Outline drawings of bushings, terminals and terminal connectors.
- 15.10 i) After approval, the Contractor shall submit Ten (10) sets of approval drawings and manuals to the Project Manager/Employer. Instruction manuals and data sheets for each rating of Equipment shall be submitted. The manuals shall clearly indicate the installation methods, checkups and tests to be carried out for testing the Equipment and maintenance procedure.

ii) In all drawings, manuals etc., reference no. of purchase order no. shall be indicated.

iii) Two sets complete in all respects with required bindings should be sent directly to the Project Manager/ Employer.

16. TEST REPORTS AND INSPECTION:

The test reports are to be submitted along with the bid and Inspections shall be carried out during Pre Shipment and Post Landing Inspection.

16.1 Type test

The Bidder shall submit along with the bid, detailed as well as complete test reports of all tests (including Type Test) as stipulated in relevant IEC with Complete identification, date and serial no., carried out in a Government recognized Test House or Laboratory/ CPRI/ NABL accredited lab/ on Circuit Breakers of identical design.

For Breaker:

- a) Short time withstand and peak withstand current test
- b) Lightning impulse voltage withstand test
- c) Temperature rise Test
- d) Mechanical Endurance Test
- e) Measurement of the resistance of the main circuit
- f) Short circuit current making and breaking tests
- g) Tightness tests.

For CT:

- a) Lightning impulse voltage(Chopped impulse and full impulse);
- b) Power frequency wet withstand voltage;
- c) Temperature rise;
- d) Short circuit withstand capability test;
- e) Current error and phase displacement
- f) Switching impulse.

For PT:

- a) Lightning impulse voltage test;
- b) High voltage power frequency wet withstand voltage;
- c) Temperature rise test;
- d) Short circuit withstand capability test;
- e) Switching impulse;
- f) Determinations of error;

16.2 Routine test**For Breaker:**

- a) Dielectric test on main, auxiliary and control circuit
- b) Measurement of the resistance of the main circuit
- c) Tightness test
- d) Mechanical operation tests
- e) Design and visual checks

For CT:

- a) Verification of terminal marking and polarity;
- b) Power frequency dry withstand test on both windings;
- c) Power frequency dry withstand test between sections;
- d) Over voltage inter-turn test;
- e) Turn ratio;
- f) Instrument security factor test;
- g) Determinations of error;
- h) Secondary winding resistance and Accuracy test ;
- i) Current error and phase displacement;
- j) Knee point voltage and magnetizing current test ;
- k) Insulation Resistance Test;

For PT:

- a) Verification of terminal marking and polarity;
- b) Power frequency dry withstand tests on both winding;
- c) Power frequency withstand tests between sections;
- d) Determination of limits of voltage errors and phase displacement;
- e) Partial discharge measurement;
- f) Insulating Resistance measurement;

16.3 Special tests

For CT:

- a) Multiple chopped impulse test on primary winding;
- b) Measurement of capacitance and dielectric dissipation test.
- c) Mechanical tests.

For PT:

- a) Chopped impulse test on primary winding;
- b) Measurement of capacitance and dielectric dissipation test.
- c) Mechanical tests.
- d) Transmitted over-voltage measurement.

17. SPECIFIC LIMIT OF AUXILIARY SUPPLY VOLTAGE:

- a) The auxiliary supply voltage shall be 80% to 110% of the rated 110 V in supply for closing coil and the same shall be 70% to 110% for tripping coil.
- b) The operating voltage for motor operated spring charged mechanism shall be 415V A.C., 3 phase, 50 Hz or 230V. 1-phase, 50 Hz. The motor shall operate at a voltage variation of 85% to 110% of the supply voltage.

18. NAME PLATE:

- i. Rated voltage/Maximum voltage
- ii. Rated insulation level
- iii. Type /Model No./Sl. No./Year of manufacture.
- iv. Rated current
- v. Rated frequency.
- vi. Rated short Circuit Breaking Current.
- vii. Rated transient recovery voltage for terminal fault.
- viii. Rated short circuit making current.
- ix. Rated operating sequence.
- x. Rated short time current.
- xi. Rated line charging/breaking current
- xii. Rated Cable charging current.
- xiii. Rated single capacitor bank charging/breaking current.
- xiv. Rated small inductive breaking current.
- xv. Rated Supply Voltage of auxiliary circuits.
- xvi. Applicable standard.

19. RECOMMENDED SPARES:

Instructions to Bidders: The Bidder shall quote item-wise price of recommended spares for 5 (five) years normal operation. The Employer will decide the actual quality of spare to be procured on the basis of the List.

20. ACCESSORIES:

Each Breaker shall be furnished complete with fittings and accessories as listed below (The list is illustrative & not exhaustive).

- i. Clamp-type terminal connectors for ACSR Conductor
- ii. Base frame and foundation/anchor bolts.
- iii. Operating mechanism, trip and close coils.
- iv. Set of valves required for gas filling.
- v. Auxiliary Contacts and Relays/Contacts.
- vi. Local/Remote selector Switch and Close/Trip Control Switch.
- vii. Manual close and trip devices.
- viii. Mechanical ON/OFF indicators.
- ix. Operation counters.
- x. Weatherproof Control cubicle and operating mechanism boxes, with locking arrangement.
- xi. Set of Switch-Fuse/MCB/MCCB units for A.C. & D.C. Supply.
- xii. Space heaters with thermostat and switch. Two units will be provided with the option to operate separately.
- xiii. Cubicle illumination Lamp with Switch.
- xiv. Terminal blocks and internal wiring.
- xv. Necessary all Main Control cables & Auxiliary Control cables. LV control cable must be armored.
- xvi. G.I. conduits and accessories for connection between Central Control Cubicle and operating mechanism boxes where applicable.
- xvii. Other standard accessories which are not specified, but are necessary for efficient and trouble free operation shall be supplied.

21. TEST AT FACTORY AND TEST CERTIFICATES

- 21.1 All Acceptance tests shall be carried out at manufacturer's works in presence of the Employer's and Contractor's representatives. In addition to above, all routine tests are also to be carried on the breakers as per relevant IEC. The entire cost of acceptance and routine test that to be carried out as per relevant IEC' shall be treated as included in the quoted price of breakers. The Contractor shall give at least 21(twenty one) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out from the date when the tests will be carried out.
- 21.2 Routine tests on all breakers, CTs and PTs shall be carried out as per IEC-62271-100, IEC 60044-1, IEC 60044-2 and test reports shall be submitted along offer.

22. WARRANTY

The Contractor shall warrant that the VCB furnished have conformed to this specification. The warranty shall state that if, within three (3) years from the date of commissioning, a VCB is found to have defects in workmanship or material (or fails in service due to such defects) the Contractor shall repair or replace such defective parts (and other parts damaged as a result) within 15 days, free of charge.

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV OUTDOOR TYPE VACUUM CIRCUIT BREAKER (VCB)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

Sl. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	System voltage	kV	33	
2	Rated voltage	KV	36	
3	Rated frequency	HZ	50	
4	Rated normal current			
	Feeder	A	1250	
5	Interrupting medium		Vacuum	
6	Number of phases		3	
7	Rated short-circuit breaking current	KA	31.5	
8	Rated short-circuit making current	KA	80	
9	First pole to clear factor		1.3	
10	Rated operating sequence		O-0.3s-CO-3min-CO	
11	Rated duration of short circuit	Sec	3	
12	Impulse withstand on 1.2/50 μ s wave	KV	170	
13	Power frequency test voltage (dry) at 50Hz, 1 min	KV	70	
14	Circuit breaker operating mechanism type		Gang operated spring charged stored energy.	
15	Operating particulars			
	a) Breaking time	ms	<60ms	
	b) Closing time	ms	70 $\pm$ 10ms	
16	Is the circuit breaker trip free with anti-pumping feature?	Yes/No	Yes	
17	Trip coil voltage	VDC	110	
18	Rated supply voltage of shunt opening release	VDC	110	
19	Spring charging motor voltage	VAC	415/230	
20	Minimum clearance in air			
	a) Between phases	mm	430	
	b) Phases to earth	mm	380	
21	Degree of protection		IP 55	
22	Auxiliary Contact			
	NO	Nos	9	
	NC	Nos	9	
23	Is lockout facility fitted		Yes	
24	Rated breaking current :			
	Line charging	KA	25	

Sl. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
	Cable charging	KA	50	
	Small inductive	KA	02	
25	Installation		Outdoor	
26	Creep age Distance	mm/kv	25	
27	Closing Coil	Nos.	01	
28	Contact Resistance	$\mu\Omega$	≤ 40	
29	Is the lockout facility fitted?		Yes	
30	Length of stroke	mm	To be mentioned	
31	All current carrying parts of VCB shall be made of		Copper	
32	Tripping Coil	Nos.	02	
33	No of operation a) At rated short circuit current b) At rated current	Nos. Nos.	100 30000	
34	Standard		IEC 62271-100	
35	Manufacturer's name & Country		To be mentioned	
36	Manufacturer of vacuum bottle		Siemens/ABB or/ALSTOM	

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV CONTROL and ENERGY METERING PANEL**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
1	CRP Manufacturer's Name		To be mentioned	
2	Country of Origin		To be mentioned	
3	Type of Cubicle		Simplex	
4	Degree of Protection		IP4X	
5	Dimension (W×D×H)	mm	To be mentioned	
6	Painting Quality		To be mentioned	
7	Panel Interior Color		To be mentioned	
8	Panel Exterior Color		To be mentioned	
9	Panel Base Frame Color		To be mentioned	
10	Thickness of Panel Materials	mm	To be mentioned	
11	Panel Earth Bar Thickness (W×D)	mm	To be mentioned	
12	Panel Earth Bar Material		Tinned Copper	
13	Mimic for Bus & Circuit		To be mentioned	
14	Wiring for DC Circuit		Multi Stranded 1100V Grade Flexible PVC Grey/Black 2.5 rm Wire	
15	Wiring for CT Circuit		Multi Stranded 1100V Grade Flexible PVC Insulated Red, Yellow, Blue & Black Color Wire for Phase & Neutral and should be minimum 4 rm cable	
16	Wiring for PT Circuit		Multi Stranded 1100V Grade Flexible PVC Insulated Red, Yellow, Blue & Black Color Wire for Phase & Neutral and should be minimum 2.5 rm cable	
17	Ferrule		To be Mentioned	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
For 33kV Incoming Feeder				
	PROTECTION (OVER CURRENT & EARTH FAULT RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK)/ ABB (Sweden/ Switzerland/ Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	
	b) Earth fault element of current		1% to at least 2000%	
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
4	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
5	Language		English	
6	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
7	Nominal Current	A	Operable in 1A & 5A (User Settable)	
8	Minimum No of LEDs	Nos	10 (Programmable)	
9	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
10	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
11	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
12	Standard Protocol	-	IEC 61850	

12	Protection Feature		Non-directional & Directional (if required)	
13	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
14	Standard		IEC 60255	
15	Bay control unit should have available	-	Yes	
16	Minimum No of Binary Input	Nos.	23	
17	Minimum No of Binary Output	Nos.	15	
18	IEC 61850 communication Protocol Supported		To be mentioned	
19	Sync Check function		To be mentioned	
20	U, I, P, Q, S, f, PF monitoring		Yes	
21	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
Trip Relay (Separate Relay for each Numerical Relay)				
22	Manufacturer's Name		To be mentioned	
23	Place of Manufacture		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland	
24	Manufacturer's Model Number		To be mentioned	
25	Type of Relay		To be mentioned	
26	Maximum Operating Time	ms	10	
27	Minimum No of Contact (NO + NC)	Nos	6 + 6	
28	Hand & Electrical reset mechanism		Yes	
29	Rated voltage	V DC	88-125V	
Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)				
30	Manufacturer's Name		Siemens/ABB/Alstom/GE	
31	Manufacturer's Model Number		To be mentioned	
32	Type of Relay		To be mentioned	
33	Design		Modular type	
Ampere Meters				
34	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
35	Manufacturer's Model Number		To be mentioned	
36	Type of meter		Digital	
37	Class of accuracy		0.5	
38	Separate meter for each phase		Yes	
39	Instantaneous rated current		To be mentioned	
40	ISF		Minimum 10	
Volt Meters with Selector Switch				

41	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
42	Manufacturer's Model Number		To be mentioned	
43	Type of meter		Digital	
44	Class of accuracy		0.5	
Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)				
45	Manufacturer's name & Country		Siemens (Germany/Switzerland)/Alsto m (UK)/ABB (Finland/Switzerland)/AEG (Germany)/Schlumberger (USA)/CEWE (UK/Italy)	
46	Model Number	-	To be mentioned	
47	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
48	Type of meter	-	Digital	
49	Class of accuracy	-	0.2	
50	Export & Import Metering		Export & Import	
Multi tariff programmable Energy meter (kWh Meter)				
51	Manufacturer's name & Country		Siemens (Germany/Switzerland)/Alsto m (UK)/ABB (Sweden)/AEG (Germany)/ Schlumberger (USA)/Landis Gyr (Switzerland/Greece)/CEWE (UK/Italy)	
52	Model Number	-	To be mentioned	
53	Number of KWh Meters	Nos.	1	
54	Class of accuracy	-	0.2S	
55	Installation		Indoor installation	
56	Number of element		3 (Three)	
57	Nominal Voltage	V	110	
58	Construction/connection		3-Phase 4-wire solidly grounded neutral	
59	Export & Import Metering		Export & Import	
60	Nominal Rated Current	A	Both 1A and 5A	

61	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr with an interval of 30 min, software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
62	Starting Current	mA	0.1% of Nominal Current	
63	Losses at Nominal Load			
64	a) Current Circuit	W, VA	To be mentioned	
65	b) Voltage Circuit	W, VA	To be mentioned	
66	Meter Constant	Imp./k Wh	To be mentioned	
67	Integration Period		30 (Thirty) Minutes	
68	Performance Curve for Balanced & Unbalanced load		To be provided	
69	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
70	Meter Service Life (Min)	Years	15 (fifteen)	
71	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
72	Memory Storage	MB		
73	i) No of Power Interruption with Date & Time		Yes	
74	ii) Latest Power Failure- Time & Date		Yes	
75	iii) Event logs		Yes	
76	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
77	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
78	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
79	GSM-GPRS Modem		Plug and Play 4G Communication Module	
80	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			

81	Manufacturer's Name		To be mentioned	
82	Country of Origin		To be mentioned	
83	Manufacturer's Model Number		To be mentioned	
84	Windows	Nos.	Minimum 16	
85	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
	Control Switch			
86	Manufacturer's Name		To be mentioned	
87	Country of Origin		To be mentioned	
88	Manufacturer's Model Number		To be mentioned	
89	Separate Discrepancy switch for CB on/off and Local Remote (L/R) selector switch		Yes	
90	1 (One) nos. breaker Emergency trip		To be provided	
91	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
For 33/11 kV Power Transformer Incoming Feeder				
	PROTECTION (DIFFERENTIAL & REF RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK)/ ABB (Sweden/ Switzerland/ Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Main protection function		Transformer differential protection with built in low impedance REF protection feature	
4	Differential characteristics		Restrained biased characteristics with stabilization during magnetizing inrush and CT saturation	
5	CT ratio matching and vector group compensation		Internally done, software based	
6	Application		For 2 winding Transformers	
7	Tripping time		Instantaneous	
8	Restricted Earth Fault		Low impedance type	
9	Back up protection function		Instantaneous & time dependent, directional & non-directional, over current & earth fault, Over excitation & Thermal Overload Protection	
10	Display options		There must be provision of displaying restraining, differential & each phase current with angle (for both winding) on the HMI	
11	Language		English	
12	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
13	Nominal Current	A	Operable in 1A & 5A (User Settable)	
14	Harmonics blocking		2 nd and 5 th harmonics	
15	HMI		Front mounted, should be suitable to access all functions, settings and	

			stored records without external computer	
16	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
17	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
18	Standard Protocol	-	IEC 61850	
19	Minimum No of LEDs	Nos	10 (Programmable)	
20	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
21	Standard		IEC 60255	
22	Bay control unit should have available	-	Yes	
23	Minimum No of Binary Input	Nos.	13	
24	Minimum No of Binary Output	Nos.	13	
25	IEC 61850 communication Protocol Supported		To be mentioned	
26	Sync Check function		To be mentioned	
27	U, I, P, Q, S, f, PF monitoring		Yes	
28	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
PROTECTION (OVER CURRENT & EARTH FAULT RELAY)				
29	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/ UK)/ ABB (Sweden/ Switzerland/ Finland)	
30	Type of relay	-	Numerical Programmable with built-in display	
31	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	
	b) Earth fault element of		1% to at least 2000%	

	current			
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
32	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
33	Language		English	
34	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
35	Nominal Current	A	Operable in 1A & 5A (User Settable)	
36	Minimum No of LEDs	Nos	10 (Programmable)	
37	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
38	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
39	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
40	Standard Protocol	-	IEC 61850	
41	Protection Feature		Non-directional & Directional (if required)	
42	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
43	Standard		IEC 60255	
44	Bay control unit should have available	-	Yes	
45	Minimum No of Binary Input	Nos.	23	
46	Minimum No of Binary Output	Nos.	15	
47	IEC 61850 communication Protocol Supported		To be mentioned	
48	Sync Check function		To be mentioned	

49	U, I, P, Q, S, f, PF monitoring		Yes	
50	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
	Trip Relay (Separate Relay for each Numerical Relay)			
51	Manufacturer's Name		To be mentioned	
52	Place of Manufacture		UK/USA/EU/Japan/Canada /Australia/ Switzerland	
53	Manufacturer's Model Number		To be mentioned	
54	Type of Relay		To be mentioned	
55	Maximum Operating Time	ms	10	
56	Minimum No of Contact (NO + NC)	Nos	6 + 6	
57	Hand & Electrical reset mechanism		Yes	
58	Rated voltage	V DC	88-125V	
	Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)			
59	Manufacturer's Name		Siemens/ABB/Alstom/GE	
60	Manufacturer's Model Number		To be mentioned	
61	Type of Relay		To be mentioned	
62	Design		Modular type	
	Separate Auxiliary Flag Relays for Transformer self-protection (i.e., OTA, OTT, WTA, WTT, MTBA, MTBT, PRDT, OLTCBA, OLTCBT, MTMOLGA, OLTCMOLGA etc.)			
63	Manufacturer's Name		To be mentioned	
64	Place of Manufacture		UK/USA/EU/Japan/Canada /Australia/ Switzerland	
65	Manufacturer's Model Number		To be mentioned	
66	Type of Relay		To be mentioned	
67	Reset type		Hand + Electrical	
	Ampere Meters			
68	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/Alstom/ Secure/ Rishabh	
69	Manufacturer's Model Number		To be mentioned	
70	Type of meter		Digital	
71	Class of accuracy		0.5	
72	Separate meter for each phase		Yes	
73	Instantaneous rated current		To be mentioned	
74	ISF		Minimum 10	
	Volt Meters with Selector Switch			

75	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Rishabh	
76	Manufacturer's Model Number		To be mentioned	
77	Type of meter		Digital	
78	Class of accuracy		0.5	
	Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)			
79	Manufacturer's name & Country		Siemens (Germany/ Switzerland)/Alstom (UK)/ ABB (Finland/ Switzerland)/ AEG (Germany)/ Schlumberger (USA)/ CEWE (UK/Italy)	
80	Model Number	-	To be mentioned	
81	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
82	Type of meter	-	Digital	
83	Class of accuracy	-	0.2	
84	Export & Import Metering		Export & Import	
	Multi tariff programmable Energy meter (kWh Meter)			
85	Manufacturer's name & Country		Siemens (Germany/ Switzerland)/ Alstom (UK)/ ABB (Sweden)/ AEG (Germany)/ Schlumberger (USA)/ Landis Gyr (Switzerland/ Greece)/ CEWE (UK/Italy)	
86	Model Number	-	To be mentioned	
87	Number of kWh Meters	Nos.	1	
88	Class of accuracy	-	0.2S	
89	Installation		Indoor installation	
90	Number of element		3 (Three)	
91	Nominal Voltage	V	110	
92	Construction/connection		3-Phase 4-wire solidly grounded neutral	
93	Export & Import Metering		Export & Import	
94	Nominal Rated Current	A	Both 1A and 5A	
95	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr with an interval of 30 min,	

			software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
96	Starting Current	mA	0.1% of Nominal Current	
97	Losses at Nominal Load			
	a) Current Circuit	W, VA	To be mentioned	
	b) Voltage Circuit	W, VA	To be mentioned	
98	Meter Constant	Imp./kWh	To be mentioned	
99	Integration Period		30 (Thirty) Minutes	
100	Performance Curve for Balanced & Unbalanced load		To be provided	
101	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
102	Meter Service Life (Min)	Years	15 (fifteen)	
103	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
104	Memory Storage	MB		
105	i) No of Power Interruption with Date & Time		Yes	
106	ii) Latest Power Failure- Time & Date		Yes	
107	iii) Event logs		Yes	
108	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
109	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
110	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
111	GSM-GPRS Modem		Plug and Play 4G Communication Module	
112	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			
113	Manufacturer's Name		To be mentioned	
114	Country of Origin		To be mentioned	
115	Manufacturer's Model Number		To be mentioned	

116	Windows	Nos.	Minimum 28	
117	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
	Control Switch			
118	Manufacturer's Name		To be mentioned	
119	Country of Origin		To be mentioned	
120	Manufacturer's Model Number		To be mentioned	
121	Separate Discrepancy switch for CB on/off and Local Remote (L/R) selector switch		Yes	
122	1 (One) nos. breaker Emergency trip		To be provided	
123	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV CURRENT TRANSFORMER (CT)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	Type		Electromagnetic induction, single phase, oil immersed outdoor	
2	Rated primary current			
	For incoming feeder	Amps	1600-800A	
	For outgoing and transformer feeder	Amps	800-400A	
3	Rated secondary current			
	For incoming, outgoing and transformer feeder	Amps	5-5-5A	
	For spare	Amps	1-1-1A	
4	Rated secondary accuracy and burden (33 kV incoming feeder & outgoing feeder & Spare)			
	a) Protection (core 1)		5P20, 30VA	
	b) Metering (core 2- dedicated for energy metering)		0.2S, 30VA	
	c) Metering(core 3- for indicating meters)		0.2S, 30VA	
	Rated secondary accuracy and burden (33 kV transformer feeder)			
	a) Protection (core 1 & 2)		5P20, 30VA	
	b) Metering (core 3- for energy meters and indicating meters)		0.2S, 30VA	
5	Rated frequency	Hz	50	
6	System voltage	kV	33	
7	Rated voltage for equipment	kV	36	
8	Short time current rating for 3 sec.	kA	31.5	
9	Extended current rating (% of rated current)	%	120	
10	Basic insulation level on 1.2 / 50 micro-sec wave	kV	170	
11	Power frequency withstand voltage (1 min, 50 Hz)	kV	70	
12	Creep age distance	mm/kv	25	
13	Bushing		Porcelain outdoor type	
14	System earthing		Effectively earthed	
15	Insulation class		A	

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
16	Standard		IEC60044-1	
17	Knee point voltage for protection (at both ratio):		The value should be sufficient to meet 5P20 at rated burden and measured CT secondary resistance.	
18	Knee point voltage for metering (at both ratio):		The value should be sufficient to meet FS<5	
19	Security factor, (FS for the metering core)		<5	

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE**FOR 33 KV VOLTAGE TRANSFORMER (VT FOR BUS & FEEDERS)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	Type		Electromagnetic induction, single phase, outdoor	
2	Rated primary voltage	kV	33/ $\sqrt{3}$	
3	Rated voltage for secondary windings	kV	0.11 / $\sqrt{3}$ and 0.11 / $\sqrt{3}$	
4	Rated secondary burden and accuracy			
	Secondary winding Core 1 (metering)	VA Class	50VA 0.2	
	Secondary winding Core 2	VA Class	50VA 3P	
5	Frequency	Hz	50	
6	Impulse withstand voltage (1.2/50 micro sec wave)	kV	170	
7	Cree page distance	mm/kV	25	
8	System earthing		Effectively earthed	
9	Power frequency withstand voltage (1min)	KV	70	
10	Partial discharge	PC	≤ 5	
12	Rated voltage factor		1.2 continuous 1.9 at 30 second	
13	Standard		IEC 60044-2	
14	Short time current rating for 3 sec.	kA	31.5	

BANGLADESH RURAL ELECTRIFICATION BOARD (REB)
PEOPLES REPUBLIC OF BANGLADESH STANDARD FOR
33 KV OFF-LOAD ISOLATOR WITH EARTH BLADE

1. SCOPE

This standard establishes the preferred ratings, application criteria, and manufacturing tolerances for outdoor gang operated, unitized, pre-assembled three-pole off-load switches to be used on 33 KV (phase-to-phase), 50 Hz, distribution systems. These switches shall be vertically mounted on supporting structure and manually operated.

2. GENERAL

Off-load Isolator furnished to REB specifications shall conform in all respects to the performance requirements stated in this standard.

3. RATINGS

33 KV Off-load Isolators shall be used in a hot humid climate, and shall meet the following temperature and altitude service conditions.

- a. Ambient temperature : 4°C to 45°C
- b. Altitude : up to 1000 meters

With ratings as summarized below:

- a. Rated Frequency - The frequency of the system on which the switch is to be used is 50 Hz.
- b. System Nominal Voltage - The highest nominal system voltage at which the isolator is to be applied.
- c. System Maximum Voltage – The highest rms Voltage at rated frequency at which the isolator is intended to operate.
- d. Rated Continuous Current - The maximum direct current, or rms current in amperes at rated frequency, which the isolator can carry continuously without exceeding the temperature limit.
- e. Rated short-time withstand Current - Rated total current, including the dc component if present that the isolator can carry for three seconds.
- f. Rated Momentary Current- Rms total current including the dc component the air- break isolator can carry for at least one (1) cycle.
- h. 33 KV off-load isolator shall have the following ratings:

Rating	REB Item No. HS-13.1250
System Frequency	50 Hz
Nominal system Voltage	33 KV
Maximum system Voltage	36 KV
Basic Insulation Level	170 KV
Rated Normal Current	For Outgoing feeder-1250 A

	For Bus Section- 2500 A
Rated Short Time Withstand Current	31.5 KA (3 Sec)
Number of Pole	3 (Three)
Installation	Outdoor Sub-stations
Type	Air
Construction	Open
Operation	Gang
Operating Mechanism	Manual
Mounting Position	Vertical on supporting structure
Standard	Design Manufacture, Testing, Installation and performance shall be accordance to the latest edition of the relevant IEC standards.

4. DESIGN FEATURES

- a. The line isolators shall be single break Pattern [Vertical break or Horizontal break (centre break)] pattern off load type with manual operating mechanism for the earth blade. There shall be interlocking arrangement with the breaker to ensure that the Isolator can only be operated with breaker in "OFF" position. Necessary controls, accessories and auxiliary operating mechanism for manual operation shall be provided in water proof outdoor boxes.
- b. The earthing device shall be gang operated & integral with the switch. The unit shall be complete with channel type mounting base, insulators, and phases coupling tube for gang operation and adjustable operating rod with insulating link and intermediate guide for operating rod.
- c. Auxiliary switch operated by the phase coupling tube shall be provided to control circuits for operating devices like indicators/alarms & interlocking with 100% spare contacts.
- d. Terminal connectors shall be suitable for ACSR Merlin/Gross Beak/HAWK/#477mcm ACSR conductor as required.
- e. Earthing steel pads shall be provided with provision of earth leads.
- f. Cable glands for multi core control/power cables as required.
- g. There shall be provisions for pad locking in "ON" & "OFF" position.
- h. Provision of Key interlocking.
- i. Mechanical interlocking between earthing device & the switch shall be provided.
- j. All accessories nuts, bolts etc. required for mounting the isolator on structure as required.
- k. All ferrous parts shall be hot dip galvanized after completion of machining. Galvanizing shall be in accordance with BS-729.
- l. All control devices shall be suitable for operation from 110 volts DC available in the control room.
- m. Isolator and earthing devices shall be accordance with IEC-129. They shall be complete with supporting steelwork and installed to permit maintenance of any section of the sub-station plat when the remainder is alive and shall be so located that the minimum safety clearances are always maintained.
- n. The air gap between terminals of the same pole with the isolator open shall be of a length to withstand a minimum impulse voltage wave of 115 percent of the specified impulse insulation rating to earth.

- o. Isolating switches shall be designed for live operation and isolators shall be hands operated.

Where used for feeders they shall be capable of switching transformer magnetizing currents.

Main contacts shall be of the high pressure line type and arcing contacts.

5. NAMEPLATE DATA

The following minimum data shall be included on the equipment nameplate:

1. Manufacturer's name and/or identification mark.
2. Isolator Type and serial number.
3. Rated nominal voltage.
4. Rated maximum voltage.
5. Rated continuous current.
6. Rated short-time current.
7. Rated impulse withstand voltage.
8. Date of manufacture.

6. DRAWINGS, DOCUMENTATION AND INFORMATION:

The following Drawings, Documents and Information shall be submitted with offer for the similar or higher capacity offered type 33KV OFF-Load Isolator and Earth Switch, otherwise the bid will be rejected:

- a) Manufacturer's authorization.
- b) Manufacturer's supply record for at least 3 years within the last 7 years mentioning purchaser's name, address, telephone number, Fax number, contract number with date, supply quantity with ratings, date of commencement & completion of supply.
- c) Satisfactory Performance certificates for at least 3 years within the last 7 years from at least 2 end users.
- d) Manufacturer's ISO 9001 certificate.
- e) Outline and General arrangement drawings of the offered type Isolator with supporting structure.
- f) Printed catalogue describing specification and technical data of the offered type Isolator.

7. Test Certificates:

The following test certificate along with test results for the similar or higher capacity offered type 33KV OFF-Load Isolator and Earth Switch of design confirming to the tender document shall submit with the offer from Internationally reputed Independent testing laboratory as per relevant IEC, otherwise the bid will be rejected. Sufficient evidence shall be submitted in support of the status of the testing laboratories.

- a) Short time & peak withstand current.
- b) Resistance measurement of the main circuit.
- c) Temperature rise.

- d) Lighting Impulse Voltage withstand.
- e) Short Circuit making performance of earth switch.

8. FACTORY TEST WITNESS

The factory test of the equipment will be witnessed at the manufacturer's plant by REB Engineers appointed by the purchaser.

Test shall be performed in accordance with the relevant IEC/BS Standards and shall be complied with offered Guaranteed Technical Particulars. All expenses for such tests shall be borne by the supplier which shall be deemed to be included in the offered price.

E. APPROVAL OF DRAWING & SPECIFICATION

Design, Drawing, specification and Technical Particulars & guarantees etc, shall be submitted to the PE by the bidder for approval, prior to the manufacturing of the goods. The bidder shall have to submit 4 (four) sets of the same for approval within 15 days from the date of issue of purchase order.

F. RECOMMENDED SPARES:

With the tender the manufacturers shall supply list of recommended spare parts for 5 years operation and maintenance with unit price quoted for each item, which shall be valid for a period of 2 years from the date of signing contract.

9. PACKAGING

33 KV off-load Isolators shall be securely packaged for shipping. Each package shall be clearly marked with manufacturers name, catalog number and REB item number.

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE FOR
33 KV ISOLATOR/EARTH SWITCH**

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

Description		Unit	BREB/PBS Requirement	Tenderer's Guaranteed Values
1.	Name of the manufacturer		Required	
2.	Switch Type & Model		Required	
3.	Rated Voltage & Frequency	KV/ H z	33,50	
4.	Maximum Continuous voltage	KV	36	
5.	Rated Current a) For feeder b) For bus section	A A	1250 2500	
6.	Rated Short time current (3 sec)	KA	31.5	
7.	Impulse withstand voltage	KV	170	
8.	Power Frequency withstand voltage (1 min)	KV	70	
9.	Creepage Distance	mm	Required	
10.	Dimension of the supporting steel structure		Required	
	Height	mm	Required	
	Width	Mm	Required	
	Length		Required	
11.	Weight of the phase units	Kg	Required	
12.	Phase center distance	Mm	Required	
13.	Period of time, equipment has been in service	Years	2	
14.	Period of time, equipment has been in manufacture	Years	5	
15.	Earth Switch		Required	
16.	Manufacturer		Required	
17.	Country of Manufacture		Required	
18.	Manufacturer type designation		Required	
19.	Reference Standard		Required	
20.	Number of years disconnector type in service		Required	
21.	Nominal system Voltage	KV	33	
22.	Highest system voltage	KV	36	
23.	Frequency	Hz	50	
24.	Rated Current	A	1250/2500	
25.	Type of operating mechanism		Hand	
26.	Contact resistance	μ	≤ 40	

Seal and Signature of the Manufacturer

Seal and Signature of the Bidder

PUBLICATION NO: 1002-1999
BANGLADESH RURAL ELECTRIFICATION BOARD (BREB)
TECHNICAL SPECIFICATION FOR 11 KV INDOOR TYPE VACUUM
CIRCUIT BREAKER/SWITCHGEAR

1. 11 KV Indoor Switchgear

1.1 General

The 11 kV switchgear shall consist of a single bus-bar, metal clad, indoor type, floor mounted, single tier integrated unit, incorporating enclosures for the circuit breaker units, bus-bars, current transformers and auxiliary wiring.

Each 11 kV CB shall be provided with a combined relay & control panel forming an integral part of the circuit breaker equipment.

The panels shall be equipped with the necessary protection control devices, indicating instruments and alarming devices, MCBs, etc.

The switchgear shall be of robust construction designed for maximum reliability of service in the tropical climate specified.

Cable boxes shall be supplied complete with glands and terminal lugs.

1.2 Clearances

Maximum insulator lengths and clearances in air shall be not less than those specified for 11 kV switchgear having 75 KVp Basic Impulse Level.

1.3 Current Ratings

All parts of the switchgear, including current transformers, shall be capable of withstanding, without thermal or mechanical damage, the instantaneous peak and the three second short time current corresponding to the rated making and breaking capacity of the circuit breakers.

All normal current specified are the minimum continuous values required under the service conditions appertaining to Bangladesh.

1.4 Circuit Breaker making and Breaking capacities

Each circuit breaker shall be capable of making and breaking short circuit faults in accordance with the requirements of IEC 56 - Circuit Breaker, at 3 phase symmetrical circuit ratings at 11 kV service voltages as stated in the schedules.

1.5 Circuit Breakers

1.5.1 Type

The 11 kV circuit breakers shall be vacuum type in accordance with IEC 56 as appropriate.

All types shall incorporate horizontal isolation facilities and be mounted on horizontal draw-out type.

1.5.2 Interchangeability of Circuit Breakers

Circuit breaker of the same type and current rating shall be interchangeable, both electrically and mechanically, but it must be impossible to interchange equipment of different current ratings.

1.5.3 Circuit Breaker Operation Mechanism

Circuit breaker closing mechanisms shall be 230-volt a.c motor wound preferably spring operated type such that the closing speed is independent of the operator.

11kV switchgear tripping shall be effected by means of 02 nos. of 110 volt dc shunt trip coil.

Each equipment shall be provided with a visual, mechanized, indicating device, which shall be positively driven in both directions to show whether the circuit breaker is "Open" or "Closed". It shall be operative when the circuit breaker is in the "Service" and "Test" locations. Lamp indication in place of a mechanical indicator will not be accepted. Operation counters shall be provided on each mechanism.

Means shall be provided for coupling the secondary circuits on the fixed portion to those on the movable portion when the circuit breaker is isolated in order to permit closing, tripping and interlock circuits to be checked for operation test purposes.

Means shall be provided for local manual mechanical tripping of circuit breakers, preferably by push buttons, shrouded to prevent inadvertent operation.

Locking facilities shall be provided so that with the circuit breaker in any location it can be prevented from being closed when it is open and from being mechanical tripped when it is closed. This requirement shall be met by the fitting of a single padlock and shall not entail the fitting of any loose components prior to the insertion of the padlock.

It shall not be possible, without the use of tools, to gain access to the tripping toggle or any part of the mechanism which would permit defeat of the locking of the mechanical tripping feature.

It shall not be possible to render the electrical tripping feature inoperative by any mechanical locking device.

1.5.4 Circuit Breaker Isolating Features

Irrespective of the operating type of unit the following shall apply.

Each circuit breaker shall be connected to the busbars and feeder circuit through plug and socket type isolating devices. The devices shall be of the "Off Load Type" but shall be suitable for operation whilst the busbars and/or feeder circuits are alive.

Isolating devices shall be interlocked with their respective circuit breakers to prevent their making or breaking load, but arrangements whereby attempted isolation of a closed circuit breaker trips the circuit breaker are not permitted.

The main circuit isolating devices and also all secondary circuit isolating contacts shall be of the self-aligning type, mounted in accessible positions to permit maintenance.

The number of auxiliary circuit isolating switches shall be sufficient to meet the facilities.

1.5.5 Interlocks

All mechanical interlocks shall be of the preventive type and shall be arranged to prevent mal operation as close as possible to the point at which mechanical force is applied, in order to prevent defeat of the interlocks by distortion of linkages. Electrical interlocks shall also function so as to prevent the closing of the circuit breaker.

Clearly labeled mechanical interlocks shall be provided which are designed to prevent:

- a) A closed circuit breaker from being withdrawn or inserted into the isolating contacts.
- b) Tripping by attempted isolation.
- c) The closing of a circuit breaker except when correctly located in Service or Test positions.
- d) A circuit breaker from being plugged into the isolation contacts if the tank is not in position
- e) A circuit breaker being closed in the service position when the secondary circuits between the fixed and moving portions are not completed.

In addition electrical interlocks may be utilized to ensure safe operation of the plant; i.e. on 11 kV transformer incoming circuits the circuit earth position shall not be operative unless the 33 kV circuit is de-energized and isolated etc.

1.5.6 Safety Shutter Devices

A set metal shutters shall be provided to cover each 3 phase group of stationary isolating contacts.

The shutters shall open automatically by a positive drive initiated by the movement of the circuit breaker. The closing operation shall also be automatic by positive drive

When padlocked closed, the shutters shall completely shroud the stationary contacts and it shall not be possible to force the shutters or part of the shutters to gain access to the stationary contacts.

To facilitate testing, means other than locking shall be provided for securing the shutters in the open position. However, such means shall be automatically cancelled when the automatic operation of the shutters restored upon reconnection of the circuit breaker.

Bus-bar shutters shall be painted signal red, colour 537 in BS 381 C, and shall be clearly and indelibly labeled "BUSBARS" in large white letter in English. The contractor may offer works which comply with different standards or codes only if, when requested by the Engineer Circuit shutters shall be painted yellow, colour 355 in BS 381 C, but shall not be lettered, except that on incoming feeders the circuit shutters shall be clearly and indelibly labeled "DANGER LIVE CABLES" in large red letters.

Voltage transformer spout shutters shall be painted yellow, colour 355 in BS 381 C. Durable phase colour identification shall be provided in a prominent position. Provision or access shall be made for lubricating the mechanical linkages.

All shutters shall be effectively earthed

Shutters shall not operate towards the fixed isolating contacts.

1.5.7 Busbars and Connections

The equipment shall be of single busbar type. Busbars and connection shall comply with applicable clauses of IEC 298 and shall be fully insulated.

The equipment shall be of single busbar type. The busbar assemblies shall be of a type which shall not rely only on air for insulation purpose.

Any earthed screen applied to the exterior of the insulation shall be securely earthed in each busbar compartments.

The insulation of the busbars and their connections shall be capable of withstanding, without damage, the thermal and mechanical effect of a through fault current equivalent to the short-time rating of the switchgear.

Access to busbars and the connections directly thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be marked clearly and indelibly "BUSBARS"

Busbars shall extensible at both ends; such extension shall entail the minimum possible disturbance to the busbar chambers. Compound filled busbar chambers are not acceptable.

1.5.8 Earthing of Metal Parts of Switchgear

All metal parts, other than those forming part of an electrical circuit, shall be connected to a hard-drawn, high conductivity, copper earth conductor on each unit, of adequate sectional area.

The frame of draw-out circuit breakers shall be connected to the earth bar through a substantial plug type contact and the plug shall be long enough to allow the busbar and feeder shutters to close before breaking contact.

Interlocking (both mechanical & electrical) must be provided to avoid accidental earthing circuit breaker in "service position".

1.5.9 Earthing of Insulations

Earthing of the switchgear and ancillary panels and auxiliary equipment shall be carried out in accordance with IEEE Standard 80 & 142 where applicable.

1.5.10 Insulators

Porcelain insulators shall be best quality electrical porcelain. The clamping surfaces of all porcelain insulators shall be accurately ground and shall be free of glaze.

Insulators of moulded or resin bonded material shall have a durable, non-hygroscopic surface finish having a high anti-tracking index.

1.5.11 Auxiliary switch

Each circuit breaker shall be provided with adequate no. auxiliary switches to interrupt the supply to the closing mechanism and to complete the trip circuit, when the circuit breaker is in the "Closed" position and to cover all the necessary indication, interlocking and control facilities with spare contacts.

Each circuit breaker shall be provided with clean auxiliary contacts for the purpose of providing remote switch and alarm indication at the remote grid supervisory centre. In addition each circuit breaker shall be provided with the necessary 50 volt dc interposing relays required to achieve remote control of the circuit breaker via a future remote grid supervisory system. All auxiliary switches shall be wired down whether in use or not to the appropriate marshaling kiosk.

1.5.12 Special Tools

One complete set, of all special tools that are necessary for the overhauling maintenance and adjustment of the whole equipment shall be provided with each switchboard. The tools provided shall be in a new condition and shall not be used for the erection of the equipment on Site.

1.5.13 Indoor Breaker Specification

The 11 kV switchgear unit indoor vacuum CB will be draw out type along with CT, 11 kV bus, 11 kV PT (3 × single phase unit – draw out type). The C.B shall have spring operating mechanism suitable for charging by motor (A.C 230 V, 1 phase) with provision of hand charging. Sufficient auxiliary contacts shall be provided for position indication, interlocks and other purposes. Two sets of independently operative trip coils shall be there. Provision for signaling of low gas pressure and ultimate lock out for very low pressure shall be provided. Anti-pumping features should be introduced with the Breaker. All the current carrying parts should be copper.

Technical Particulars of 11 kV Circuit Breakers:

Phase	3-phase
PG5A	

Service Voltage/Maximum system Voltage	11kV/12 kV
Continuous rating current of Bus-bar	2500 Amps.
Continuous rating current	2000A (Incomer), 2000A (Bus Section), 630A (Feeder).
Basic Impulse Level (BIL)	75 kV,
Power frequency withstand voltage	28 kV.

Bus Shall be 3 phase, 50Hz, 2500A, air insulated capable of withstanding **31.5** kA for 3 sec.

1.5.14 Current Transformers (CTs).

The current transformer rated current ratio shall match the connected load circuit and secondary circuit requirements.

Current transformers shall be capable of withstanding without damage the full load, peak and rated short time currents of their associated equipment.

Where space within a current transformer chamber permits dedicated current transformers shall be used for protection, instrumentation and metering.

Current transformers used for energizing indicating instruments and metering shall be of Class 0.2 accuracy in accordance with IEC 185

Current transformers for protective and protective/indication purposes shall be designed to suit the particular requirements of the associated protection, which in general shall be in accordance with the recommendations given in BS 3938 or approved equivalent.

Class 5p current transformers shall be used for inverse time over-current and/or earth fault protection. The rated accuracy limit current shall be equivalent to the maximum symmetrical three phase fault current or earth fault current of the protected circuit or equivalent to the switchgear breaking capacity unless otherwise approved by the Engineer. The current transformers shall be capable of meeting the 5p error classification at rated accuracy limit current over the full range of relay settings, unless otherwise approved by the Engineer.

Current transformers used for indication/metering purposes shall be designed to saturate at a value of primary current sufficiently low to protect the secondary circuit from damage at all possible values of primary fault current up to the associated primary short time thermal rating.

Current transformers for combined purposes (e.g. protection relays and indicating meters) shall have a dual Class 5p/Class 1 performance, and the secondary circuit shall have an approved means (saturating reactor or saturating interposing C.T.) of protecting the meters and reducing their burden under system fault conditions.

The rated volt-amp output of each current transformer shall not be less than 110% of the connected burden as installed in service, the burden of cable connections being taken into account.

The secondary windings of each set of current transformers shall be earthed at one point only via an accessible bolted disconnecting link, preferably located within the relay cubicle.

Where double-ratio secondary windings are specified provided a label shall be provided at the secondary terminals of the current transformer indicating clearly the connections required for either tap. The connections and the ratio in use shall be indicated on all connection diagrams.

Design magnetization curves and d.c resistance values shall be submitted before manufacture for each current transformer used for protective purposes and shall be subsequently verified by works routine tests and also by site commissioning tests.

Where current transformers have to operate or be mounted on apparatus provided under other contracts, the Contractor shall be responsible for ensuring design and installation compatibility with other Contractors and for keeping the Engineer informed.

Metal clad switchgear current transformers shall be located on the non-bus-bar side of the circuit breaker except where current transformers are provided on both sides of the circuit breaker for protection zone overlap. The primary conductors shall be accessible for primary current injection treating on site.

1.5.15 Voltage Transformers (VTs)

Voltage transformers shall comply with the requirements of IEC 186 with amendments and supplements and shall be of:-

- Class 3P accuracy for protection/indicating instruments
- Class 0.2 accuracy for tariff metering or acceptance efficiency testing.

The VA output shall be 50% in excess of the design requirements except for tariff metering voltage transformers which shall be at least 10% in excess of the design requirements.

For tariff metering voltage transformers the Contractor shall check the total installed secondary burden and if necessary shall install dummy burdens to achieve the calibrated accuracy.

Voltage transformer secondary circuit shall be earthed at one point only and metal cases shall be separately earthed. The transformers core, where accessible, shall also be separately earthed.

All voltage transformers in the system at a given voltage level shall be earthed in the same manner.

Where it is required to earth the primary neutral of a metal clad three- phase voltage transformer, the neutral earthing connection shall be insulated and brought out separately from the tank earthing connection. Means shall be provided to maintain the tank earthing connection while the voltage transformer is being withdrawn.

Where three single-phase voltage transformers are supplied for protection purposes, star connected secondary windings shall have the star point formed by insulated connections and shall be earthed at a common point.

Where necessary for earth fault protection, voltage transformers shall be of five- limbed core construction.

Where possible primary windings shall be connected through fuses with current limiting features.

Secondary MCB's shall be provided as close as possible to each voltage transformer and labeled to show their function and phase colour. The secondary circuits shall be monitored individually to detect and alarm individual fuse failure or MCB trip and to block protection operation if required.

Voltage transformers shall be designed that saturation of their cores does not occur when 1.732 times normal voltage is applied to each winding.

Magnetization curves shall be submitted for approval for each type of voltage transformer.

The standard secondary voltage between phases shall be 110 volts unless special circumstances dictate otherwise, and are approved by the Engineer.

Secondary circuits from different voltage transformers, or separate windings of the same transformer, shall not be connected in parallel.

Voltage transformers shall be connected on the non-busbar side of circuit breakers unless otherwise approved by the Engineer.

1.6 TEST CERTIFICATE OF 11 KV INDOOR TYPE CIRCUIT BREAKER.

Bidders shall submit with their offer the test certificate along with the test results of 11 KV Panel board including Circuit Breaker for the following tests carried out in accordance with IEC-56 and other international standard or latest revision thereof from an internationally recognized independent and reputable testing authority like KEMA- Holland/CESI Italy/UL-USA etc.

A. Type Tests:

For Breaker:

- a) Short time withstand and peak withstand current test
- b) Lightning impulse voltage withstand test
- c) Temperature rise Test
- d) Mechanical Endurance Test
- e) Measurement of the resistance of the main circuit
- f) Short circuit current making and breaking tests

For CT:

- g) Lightning impulse voltage(Chopped impulse and full impulse);
- h) Power frequency wet withstand voltage;
- i) Temperature rise;
- j) Short circuit withstand capability test;
- k) Current error and phase displacement
- l) Switching impulse.

For PT:

- g) Lightning impulse voltage test;
- h) High voltage power frequency wet withstand voltage;
- i) Temperature rise test;
- j) Short circuit withstand capability test;
- k) Switching impulse;
- l) Determinations of error;

For Control Panel & Relays:

Required tests as per relevant IEC Standard.

B. Routine test

For Breaker:

- f) Dielectric test on main, auxiliary and control circuit
- g) Measurement of the resistance of the main circuit

- h) Tightness test
- i) Mechanical operation tests
- j) Design and visual checks

For CT:

- l) Verification of terminal marking and polarity;
- m) Power frequency dry withstand test on both windings;
- n) Power frequency dry withstand test between sections;
- o) Over voltage inter-turn test;
- p) Turn ratio;
- q) Instrument security factor test;
- r) Determinations of error;
- s) Secondary winding resistance and Accuracy test ;
- t) Current error and phase displacement;
- u) Knee point voltage and magnetizing current test (for PS class);
- v) Insulation Resistance Test;

For PT:

- g) Verification of terminal marking and polarity;
- h) Power frequency dry withstand tests on both winding;
- i) Power frequency withstand tests between sections;
- j) Determination of limits of voltage errors and phase displacement;
- k) Partial discharge measurement;
- l) Insulating Resistance measurement;

Note: The test certificate for 3 phases, 50 Hz, 11 KV circuit breaker of rated current offered for the type (Manufacturer's designed type) shall be submitted. However, the test certificates for circuit breakers of the offered manufacturer's designated type and voltage class as per tender requirement and having higher rated current shall also be accepted. All the aforesaid tests shall be carried out in one random selected circuit breaker. The different tests carried out on different circuit breakers shall not be accepted. The tender will be considered non responsive in absence of test certificates and the supply records.

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE

11 KV SWITCHGEAR AND CONTROL EQUIPMENT

(to be filled up by the manufacturer with appropriated data, otherwise the Tender will be rejected)

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
1	Manufacturer's Name & Address		To be mentioned	
2	Applied standard		To be mentioned	
3	Rated nominal voltage	kV	11	
4	Rated Voltage	kV	12	
5	Rated current for bus	A	2500	
6	Rated short time current	kA	31.5	
7	Short time current rated duration	Sec.	03	
8	Type		VCB	
9	Vacuum Interrupter Manufacturer		ABB/ Siemens or Alstom	
	INCOMING FEEDER SWITCHGEAR UNITS			
	Circuit Breaker:			
10	Rated Voltage	kV	12	
11	Rated Current	A	2000	
12	Rated short Ckt. Breaking current, 3 Sec.	kA	31.5	
13	Rated short Ckt. Making current	kA	80	
14	First pole to clear factor	1.5		
15	Rated breaking time	Cycle	< 3	
16	Opening time	ms	≤ 60	
17	Closing time	ms	≤ 70	
18	Contact resistance	μΩ	< 40	
19	No of Operation a) At Rated short circuit current b) At rated current	Nos Nos	100 30000	
20	Rated operating sequence	0-0.3 sec-CO-3 min-CO		
21	Control voltage	V	DC 110	
22	Motor voltage for spring charge	V	AC 180-240	
23	No. of Trip coil	No.	02	
	Current Transformer:			
24	Rated Voltage	kV	12	
25	Accuracy class, Metering	0.2S		
26	Accuracy class, Protection	5P20		
27	Accuracy class, Protection	5P20		
28	Rated current ratio	A	2000-1000:5-5-5	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
29	Factor of security	≤ 5		
30	Burden (At both ratio)	VA	20	
31	Rated frequency	Hz	50	
	Insulation level			
32	AC withstand voltage 1 min. dry	kV	28	
33	Impulse withstands, full wave	kV	75	
	Degree of Protection			
34	Enclosure	IP4X		
35	HV Compartment	IP65		
36	LV Compartment	IP40		
	Bus bar			
37	Material		Copper	
38	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
39	Height	mm	To be mentioned	
40	Width	mm	To be mentioned	
41	Depth	mm	To be mentioned	
42	Weight including Circuit Breaker	Kg.	To be mentioned	
	Voltage Transformer			
43	Number of phases		To be mentioned	
44	Rated primary voltage	kV	11/√3	
45	Rated secondary voltage	V	110/√3	
46	Rated burden (both Metering & Protection)	VA	50	
47	Accuracy class for metering		0.2	
48	Accuracy class for protection		3P	
	Power Fuse			
49	Rated voltage	kV	12	
50	Rated current	A	To be mentioned	
51	Rated short Ckt. breaking current, 3 Sec.	kA	31.5	
	BUS SECTIONALIZER SWITCHGEAR UNIT WITH RISER			
	Circuit Breaker:			
52	Rated Voltage	kV	12	
53	Rated Current	A	2000	
54	Rated short Ckt. breaking current, 3 Sec.	kA	31.5	
55	Rated short Ckt. making current	kA	80	
56	First pole to clear factor		1.5	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
57	Rated breaking time	Cycle	< 3	
58	Opening time	ms	≤ 60	
59	Closing time	ms	≤ 70	
60	Contact resistance	μΩ	< 40	
61	No of Operation At Rated short circuit current b) At rated current	Nos Nos	100 30000	
62	Rated operating sequence		0-0.3 sec-CO-3 min-CO	
63	Control voltage	V	DC 110	
64	Motor voltage for spring charge	V	AC 180-240	
65	No. of Trip coil	No.	02	
	Current Transformer:			
66	Rated Voltage	kV	12	
67	Accuracy class, Protection		5P20	
68	Accuracy class, Metering		0.2S	
69	Rated current ratio	A	2000-1000:5-5	
70	Factor of security	≤ 5		
71	Burden (At both ratio)	VA	20	
72	Rated frequency	Hz	50	
	Insulation level:			
73	AC withstand voltage 1 min. dry	kV	28	
74	Impulse withstands, full wave	kV	75	
	Degree of Protection			
75	Enclosure		IP4X	
76	HV Compartment		IP65	
77	LV Compartment		IP40	
	Earthing Switch:			
78	Type		To be mentioned	
79	Short Time Current, 3Secs.	kA	31.5	
	Busbar:			
80	Material		Copper	
81	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
82	Height	mm	To be mentioned	
83	Width	mm	To be mentioned	
84	Depth	mm	To be mentioned	
85	Weight including Circuit Breaker	kg.	To be mentioned	
86	Type	To be mentioned		
	Busbar:			

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
87	Material		Copper	
88	Cross Section	mm ²	To be mentioned	
89	Rated nominal voltage	kV	11	
90	Rated Voltage	kV	12	
91	Rated current for bus	A	2500	
92	Rated short time current	kA	31.5	
93	Short time current rated duration	Sec.	3	
	LINE FEEDER SWITCHGEAR UNITS			
	Circuit Breaker:			
94	Rated Voltage	kV	12	
95	Rated Current	A	630	
96	Rated short Ckt. Breaking current, 3 Sec.	kA	31.5	
97	Rated short Ckt. Making current	kA	80	
98	First pole to clear factor		1.5	
99	Rated breaking time	Cycle	< 3	
100	Opening time	ms	≤ 60	
101	Closing time	ms	≤ 70	
102	Contact resistance	μΩ	< 40	
103	No of Operation a) At Rated short circuit current b) At rated current	Nos Nos	100 30000	
104	Rated operating sequence		0-0.3 sec-CO-3 min-CO	
105	Control voltage	V	DC 110	
106	Motor voltage for spring charge	V	AC 180-240	
107	No. of Trip coil	No.	02	
	Current Transformer:			
108	Rated Voltage	kV	12	
109	Accuracy class, Metering		0.2S	
110	Accuracy class, Protection		5P20	
111	Rated current ratio	A	600-300:5-5	
112	Factor of security	≤ 5		
113	Burden (At both ratio)	VA	20	
114	Rated frequency	Hz	50	
	Insulation level			
115	AC withstand voltage 1 min. dry	kV	28	
116	Impulse withstands, full wave	kV	75	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
	Degree of Protection			
117	Enclosure	IP4X		
118	HV Compartment	IP65		
119	LV Compartment	IP40		
	Bus bar			
120	Material		Copper	
121	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
122	Height	mm	To be mentioned	
123	Width	mm	To be mentioned	
124	Depth	mm	To be mentioned	
125	Weight including Circuit Breaker	Kg.	To be mentioned	
	Voltage Transformer			
126	Number of phases		To be mentioned	
127	Rated primary voltage	kV	11/√3	
128	Rated secondary voltage	V	110/√3	
129	Rated burden (both Metering & Protection)	VA	50	
130	Accuracy class for metering		0.2	
131	Accuracy class for protection		3P	
	Power Fuse:			
132	Rated voltage	kV	12	
133	Rated current	A	To be mentioned	
134	Rated short Ckt. breaking current	kA	31.5	
	Dimension and Weight			
135	Height	mm	To be mentioned	
136	Width	mm	To be mentioned	
137	Depth	mm	To be mentioned	
138	Weight including Circuit Breaker	kg.	To be mentioned	
	Degree of Protection			
139	Enclosure		IP4X	
140	HV Compartment		IP65	
141	LV Compartment		IP40	
142	Insulation Level	kV	To be mentioned	
143	All current carrying path must be copper.			

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
	11 kV CONTROL RELAY AND ENERGY METERING PANEL			
	PROTECTION (OVER CURRENT & EARTH FAULT RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK) ABB (Sweden/Switzerland/Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	
	b) Earth fault element of current		1% to at least 2000%	
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
4	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
5	Language		English	
6	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
7	Nominal Current	A	Operable in 1A & 5A (User Settable)	
8	Minimum No of LEDs	Nos	10 (Programmable)	
9	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
10	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
11	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
12	Standard Protocol	-	IEC 61850	
13	Protection Feature	-	Non-directional & Directional (for Incomer)	
14	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
15	Standard		IEC 60255	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
16	Bay control unit should have available		Yes	
17	IEC 61850 communication Protocol Supported		To be mentioned	
18	Sync Check function		To be mentioned	
19	U, I, P, Q, S, f, PF monitoring		Yes	
20	No of Communication Ports (rear) i) Optical ii) Electrical (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned To be mentioned	
21	Minimum Number of Binary Input		16 nos	
22	Minimum Number of Binary Output		10 nos	
	Trip Relay (Separate Relay for each Numerical Relay)			
23	Manufacturer's Name		To be mentioned	
24	Place of Manufacture		UK/USA/EU/Japan/Canada/Australia/Switzerland	
25	Manufacturer's Model Number		To be mentioned	
26	Type of Relay		To be mentioned	
27	Maximum Operating Time	ms	10	
28	Minimum No of Contact (NO + NC)	Nos	6 + 6	
29	Hand & Electrical reset mechanism		Yes	
30	Rated voltage	V DC	88-125V	
	Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)			
31	Manufacturer's Name		Siemens/ABB/Alstom/GE	
32	Manufacturer's Model Number		To be mentioned	
33	Type of Relay		To be mentioned	
34	Design		Modular type	
	Ampere Meters			
35	Manufacturer's Name		Siemens/ ABB/ GE/ CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
36	Manufacturer's Model Number		To be mentioned	
37	Type of meter		Digital	
38	Class of accuracy		0.5	
39	Separate meter for each phase		Yes	
40	Instantaneous rated current		To be mentioned	
41	ISF		Minimum 10	
	Volt Meters with Selector Switch			
42	Manufacturer's Name		Siemens/ABB/GE/CEWE/Schlumberger/ AEG/Alstom/ Secure/ Rishabh	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
43	Manufacturer's Model Number		To be mentioned	
44	Type of meter		Digital	
45	Class of accuracy		0.5	
	Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)			
46	Manufacturer's name & Country		Siemens (Germany /Switzerland) / Alstom (UK)/ ABB (Finland/ Switzerland) /AEG (Germany)/ Schlumberger (USA)/ CEWE (UK/Italy)	
47	Model Number	-	To be mentioned	
48	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
49	Type of meter	-	Digital	
50	Class of accuracy	-	0.2	
51	Export & Import Metering		Export & Import	
	Multi tariff programmable Energy meter (kWh Meter)			
52	Manufacturer's name & Country		Siemens (Germany/Switzerland)/ Alstom (UK)/ ABB (Sweden)/ AEG (Germany)/ Schlumberger (USA)/ Landis Gyr (Switzerland/Greece)/ CEWE (UK/Italy)	
53	Model Number	-	To be mentioned	
54	Number of KWh Meters	Nos.	1	
55	Class of accuracy	-	0.2S	
56	Installation		Indoor installation	
57	Number of element		3 (Three)	
58	Nominal Voltage	V	110	
59	Construction/connection		3-Phase 4-wire solidly grounded neutral	
60	Export & Import Metering		Export & Import	
61	Nominal Rated Current	A	Both 1A and 5A	
62	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr with an interval of 30 min, software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
63	Starting Current	mA	0.1% of Nominal Current	
64	Losses at Nominal Load			
	a) Current Circuit	W,	To be mentioned	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
		VA		
	b) Voltage Circuit	W, VA	To be mentioned	
65	Meter Constant	Imp./ kWh	To be mentioned	
66	Integration Period		30 (Thirty) Minutes	
67	Performance Curve for Balanced & Unbalanced load		To be provided	
68	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
69	Meter Service Life (Min)	Years	15 (fifteen)	
70	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
71	Memory Storage		MB	
72	i) No of Power Interruption with Date & Time		Yes	
73	ii) Latest Power Failure- Time & Date		Yes	
74	iii) Event logs		Yes	
75	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
76	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
77	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
78	GSM-GPRS Modem		Plug and Play 4G Communication Module	
79	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			
80	Manufacturer's Name		To be mentioned	
81	Country of Origin		To be mentioned	
82	Manufacturer's Model Number		To be mentioned	
83	Windows	Nos.	Minimum 12	
84	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
85	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

BANGLADESH RURAL ELECTRIFICATION BOARD (BREB)

TECHNICAL SPECIFICATION FOR SUBSTATION AUTOMATION SYSTEM

Overview

The Substation Automation System (SAS) shall comprise of the following subcomponents:

- Substation Control System (SCS)
- Communications Network
- Time Synchronization
- Substation Human Machine Interface (HMI)
- Engineering Workstation (EWS)
- SAS Integration with Substation

Note that in all design aspects, cybersecurity principles shall underpin the SAS implementation.

The SAS shall be responsible for all data acquisition, automation, monitoring and control of the substation electrical infrastructure which is largely based on a modern substation automation system design. The SAS shall use the internationally recognized IEC 61850 suite of standards for protection, automation & control. The gateway and substation HMI shall communicate with all the protection IEDs for SAS data using its embedded IEC 61850 MMS Client. **The Gateway shall be a separate device, not built in with the HMI.**

The physical device name of the IED in the CID file is critical and used as part of the object model defined in the IEC 61850 standard. The naming convention that will be used will be applied consistently across all Software Configuration Tools.

The substation gateway, mounted in a dedicated gateway cabinet, shall subscribe to the configured report control blocks (RCBs) in each IED in order to retrieve SAS data contained in predefined datasets. There are two types of reporting schemes detailed in the standard as part of the IEC 61850 MMS Client which shall be used. These are the buffered and unbuffered report control blocks. All digital inputs (alarms/indications/protection trips) that must be sent to the gateway shall be assigned to two datasets associated with Buffered Report Control Blocks (BRCBs). All analogue data (power, voltage, current, etc.) that must be sent to the gateway shall be configured in datasets associated with Un-buffered Report Control Blocks (URCB). URCB's do not buffer any state changes during a communication failure between the gateway and the IED. The varying nature of analogue quantities justifies the use of URCBs in order to optimize the memory resources of the IED for other critical tasks. Furthermore, the use of BRCB's ensures that critical indications/trips are preserved/buffered should a communication loss between the substation gateway and the IED occur. **The connection from the IED's shall be redundant.**

The list of signals for the substation will be made available during the Factory Acceptance Test (FAT) of the SAS.

The Substation gateway shall aggregate data received from the substation and perform the task of a gateway to exchange the required signals to the BREB SAS Master station. The SAS shall communicate to the BREB Control Centre using the IEC 60870-5-104 tele-control protocol.

The Protection IED's shall comply fully with the IEC 61850 Edition 2.1 standards or later edition, as applicable.

The managed Ethernet network that is to be installed shall be substation hardened to IEC 61850-3 and shall accommodate redundant 48 Vdc power supplies. 19” rack-mountable switches are preferred, with the prerequisite that the network shall accommodate all the devices that will connect to it and provide for 25% spare port capacity. The devices shall be mounted in the gateway cabinet. All fibre optic connections to the switches will be realised via rodent-resistant ruggedized fibre optic cables using LC connectors and at least four copper ports shall be included for engineering use.

Critical station alarms monitoring is achieved by means of an IEC 61850 compliant remote I/O unit which will be mounted in the gateway cabinet. These alarms include but are not limited to VT fail alarms, DC fail alarms, charger alarms, AC fail alarms, IED (relay) watchdog alarms, etc. The complete list of station alarms which are hard-wired to the I/O unit will be made available during the Factory Acceptance Test (FAT) of the SAS.

The I/O unit(s) shall communicate to the gateway via IEC 61850 MMS and shall be treated as substation IEDs in the SAS.

While IEC 61850 is the preferred communications standard for all substation devices, it is acknowledged that some devices may only support alternative communications standards. As such, Modbus/TCP will be acceptable for intelligent battery chargers and the integration of meter readings into the Substation Automation System.

Every meter, battery charger, MCCB status of ACDB & DCDB shall be incorporated with SAS through MODBUS/DLMS COSEM protocol.

Detailed GTPs for the SAS, every component in the control room (relay, meter trip relay, trip coil, supervision coil, energy meter), as well as the requirements of the 11kV PCM panel and 33kV PCM panel (Feeder, Transformer, Indoor AIS) shall be included with the tender documents long with the corresponding GTPs.

It must be noted that the design requirements of the 33 kV control, signalling and relay panel and the design requirements of the SAS system shall be different.

Naming and conventions

An IEC 61850 dataset containing Functionally Constrained Data Attribute items shall be named according to its intended purpose once associated with a GOOSE Control Block. For example, a dataset containing items to be used for interlocking may be called CTRL or ILOCK and a dataset containing items to be used for tripping purposes (including breaker fail) may be called TRIPS.

A GOOSE Control Block shall be configured according to the following:

- The MAC address shall reflect the source bay number in the last byte of the multicast MAC address. The number shall depict the decimal number of the bay. This is done to assist in locating GOOSE messages in monitoring tools such as Wireshark.
- The App ID field shall be structured to indicate the source bay number in the first byte and the GOOSE instance in the second byte.
- The GOOSE VLAN ID and Priority shall be as shown agreed in the detailed design phase.
- The GOOSE Application ID (GoID) shall be named by using a unique bay identifier.

Furthermore, if the primary purpose of the GOOSE message is for trip signalling, then the name shall reflect such.

IEC 61850 GOOSE Dataset contents

The items in a dataset to be associated to a GOOSE Control Block shall be sourced from the logical node that describes the functionality and shall not be taken via any other signal manipulation (e.g. the Disturbance Recorder function block) first. For example, an earth switch position shall be sourced from the Pos DPC (ST FC) of the XSWI or CSWI logical node.

IEC 61850 GOOSE Control Block and Dataset locations

All Datasets and GOOSE Control Blocks for an IED shall be located in LLN0 of Logical Device 0 (LD0), or equivalent logical device, of said IED.

IED Logic requirements

The logic associated with an IED shall be performed in the IED itself. No logic shall be partially implemented in the GOOSE transmitting IED as this makes troubleshooting extremely cumbersome.

All inputs (physical as well as GOOSE virtual inputs) shall be modelled by passing the inputs to the appropriate function block reflecting the IEC 61850 Logical Node that represent the signal.

Substation Control

General

Local control at the substations is achieved by means of the user interface of the IED in each protection scheme as described above. A touchscreen capable IED is therefore preferred with a colour display. In addition, a substation HMI shall be available at the substation for centralised local control and monitoring.

The IEDs shall be required to present a bay “mimic” for monitoring and operating purposes.

Any switching sequencing as well as interlocking functionalities are also the responsibility of the IEDs.

Accurately timestamped alarms and indications are to be made available to the substation gateway by means of IEC 61850 MMS reports.

Inter-device signalling to be achieved by means of IEC 61850 GOOSE messaging. The use of GOOSE provides for simplified data exchange.

Local Control

Control from the bay control and/or protection IEDs shall be realised by means of the graphical bay mimics displayed on the IEDs. IED faceplate pushbuttons shall be used to control switchgear positions provided the Local/Remote selection is in the Local position.

The following additional safety measures shall be employed when operating the MV switchgear board:

- Manual control shall only be possible by means of a stand-off pendant switch with a long cable (umbilical cord) to allow the operator to stand a safe distance away from the board;
- Control from the IED pushbutton shall be time-delayed for example by 15 seconds to allow the operator to initiate the control and have enough time to clear the vicinity and stand a safe distance away from the board.

Substation HMI

A substation HMI is the preferred operating interface to be used for monitoring and control with the aim of ensuring safety and minimizing operating errors.

The HMI shall be an independent system and may be an integral component of the gateway devices provided the HMI functionality is not impeded due to its integration.

Remote Control

Remote control shall be facilitated by means of a communication gateway that will be connected to the BREB Control Centre by means of the IEC 60870-5-104 communications standard.

Cybersecurity in the form of electronic perimeter protection shall be realized by means of a network security appliance that is recognized as a leader in the industry-recognized Gartner Magic Quadrant.

The device shall be capable of deep packet inspection of IP traffic including Industrial Control System protocols such as IEC 60870-5-104, and IEC 61850, packets. The proposed cybersecurity device shall be compliant with IEC 61850-3 and must be centrally manageable.

The HMI/gateway cabinet shall house an IEEE 1588v2 Power Profile capable, GPS synchronized clock with IRIG-B, NTP and PTP capabilities for substation-wide time synchronization purposes.

Engineering Workstation

The Engineering Workstation (EWS) shall be a substation-hardened industrial computer that shall provide the necessary functionality and graphical interface for configuring, managing and collecting information and records from the Substation Automation System (SAS).

The EWS shall be required to:

- Provide a central “on-site” repository of the configuration management for the entire substation system. This includes drawings, manuals and component configurations.
- Storage and display of disturbance records - All recorded data from the IEDs with integrated disturbance recorders shall be automatically uploaded via IEC 61850 (event triggered or once per day) to the EWS and stored on the mass storage device. Retrieval may be facilitated via the gateway device.
- Disturbance analysis – The EWS shall have all the necessary software to evaluate all the required information for comprehensive post-fault analysis.
- IED parameter settings – It shall be possible to access all the Protection IEDs from the EWS. The setting of parameters or the activation of parameter sets shall only be allowed from the EWS after authenticating and authorizing the user appropriately.

The EWS shall be rack-mountable and shall be mounted in the Gateway Panel.

The EWS shall communicate via IEC 61850 to all the IEDs in the SAS. SNMP shall be used to communicate with the substation LAN equipment.

Substation Communications Infrastructure (Substation LAN)

A fibre optic network will be deployed within the substation building for local communications to all the IEDs, HMIs and Gateway.

An industrial-grade, substation hardened, switched Ethernet network shall be used to manage the fibre optic network infrastructure at the substations.

The network topology shall be such that each IED shall connect directly to the network switches using both network interfaces in a parallel redundancy configuration (using PRP). No ring topologies shall be permitted particularly where the IEDs are required to be an integral part of the network topology.

The substation switches shall support the Precision Timing Protocol as per the IEEE 1588v2 Power Profile standard. Non-PRP capable equipment shall integrate via a suitable RedBox solution. No proprietary redundancy solutions shall be acceptable.

The switches shall be configured to isolate the different traffic types into dedicated Virtual Local Area Networks (VLANs).

GOOSE messages shall take full advantage of traffic separation using VLAN IDs and data prioritization. Multicast MAC addresses must be significant and must relate to the source IED. Other GOOSE parameters shall also be significant and shall relate to the source IED.

The fundamental design criteria for the implementation of a communications networks in a SAS is high availability, high reliability and maintainability. The system design shall provide a solution employing the abovementioned design criteria to derive the maximum benefits from an IEC 61850 Substation Automation System. High availability shall be realized by means of a design using redundant devices and redundant cabling where this is practically achievable. High reliability is achieved by product selection based on industrial networking principles and guidelines. The product selection shall exceed minimum build-quality and design-quality criteria. Maintainability shall be realized through suitable network monitoring and configuration management. These switches are shall be ruggedized industrial Ethernet devices which shall be compliant to the following typical requirements:

- Rated for reliable operation in harsh electrical environments:
 - IEC 61850-3 and IEEE 1613 (Electric power substations)
 - IEC 61000-4
 - IEC 60068-2
 - IEC 60255-21
- Rated for error free operation in high EMI environments:
 - IEEE 1613 Class 2 error free performance under EMI stress for fibre-based networking devices
 - IEC 60255-26
 - IEC 61000-4
- Fibre optic ports should support both short (SX) and long haul fibre (LX)
- Rated for operation over a wide temperature range:
 - -40°C to 85°C (+185°F)
 - Passive cooling – no fans.
- Rated for high availability:
 - Dual redundant power supplies
- Industrial terminal blocks for power and I/O connections

IP address allocations

All IP addresses configured for the Substation Automation Systems shall be within the private range (RFC1918 – Address Allocation for private internets) of available IPv4 addresses as assigned by the Internet Assigned Numbers Authority (IANA).

The allocation shall be done according to the Classless Inter-Domain Routing (CIDR) method as defined by the Internet Engineering Task Force (IETF).

A typical IP address range that shall be used for the Substation Automation systems shall take the form of a typical range such as 172.16.X.0/22 and this range shall be further subnetted and allocated as described in table below.

Network Address	Allocation
172.16.X.0/25	Network Management
172.16.X.128/25	Engineering Access
172.16.X.0/24	Substation Automation System (SAS) Network
172.16.X.0/24	Tariff meters
172.16.X.0/24	Unallocated at present

Virtual Local Area Networks (VLANs)

Virtual local Area Networks (VLANs) shall be applied on the system to manage the efficiency on the network. The managed Ethernet switches will be configured with a weighted round robin (WRR) Quality of Service (QoS) regime.

The following VLANs are used on the system:

- Substation Automation System VLAN
- GOOSE VLAN
- Management VLAN
- Engineering VLAN
- Metering VLAN

Time synchronization

Time Synchronization forms a critical component of the SAS. A rack-mounted GPS Clock (residing in the Gateway cabinet) shall be the reference clock (NTP stratum 0) in the SAS. The GPS clock shall be designed to operate in substation environments with ± 100 ns accuracies. This clock synchronizes to UTC using GPS satellite transmissions that are received via the GPS antenna. A surge arrestor shall be mounted and earthed in the substation gateway panel and shall be connected to the antenna on one side and the GPS clock on the other side thereby providing protection for the GPS clock.

The SAS shall incorporate two time servers, a main and a backup time server (which may be located at the control centre) for time synchronization redundancy. The time servers shall distribute the time to all IEDs using the Network Time Protocol (NTP). Each IED shall be configured with a main and backup NTP server with a 60s refresh rate. Should the main NTP server fail, the IEDs will request time from the backup NTP server. In addition, the managed Ethernet switches, I/O units, Engineering Server, etc., shall be time synchronized using NTP. The following settings and philosophies will be applied in the SAS:

- Bangladesh is in the Bangladesh Standard Time (BST) time zone with an offset of +6 hours from UTC.
- Each IED in the SAS will be configured with the BST time-zone offset.
- All time distribution shall be done in UTC time.
- Daylight savings is not observed in Bangladesh. Hence, no Daylight Savings Time (DST) subtraction from UTC time will be done.

Loss of satellite communications will actuate the alarm contact which is wired to the I/O unit.

Substation Human Machine Interface (HMI)

The Substation Human Machine Interface (HMI) system in the substations shall be responsible for meeting the following objectives required for a Substation Automation System (SAS):

- Provides a user interface for the engineer/operator to safely monitor and control the electrical infrastructure at the substation.
- Provides limited visualization and analysis capabilities for power system measurands and disturbances.
- Centrally managed annunciator system, historical alarm summary/sequence of events (SoE) and control operation logs.

Technical Specification of Substation Automation System (SAS)

Scope of Supply

This specification covers the design, manufacture, inspection, testing at the manufacturer's works and erection and commissioning of a Substation Automation System described in the following sections, to control and operate the 33/11KV AIS substation.

This describes the facilities required to provide the control of plants and systems within a substation and outlines the facilities to be provided on site, interface requirements and performance criteria. The Substation Automation System (SAS) shall comprise full station and bay protection, control, monitoring and communication functions. It shall enable local station control via PC by means of a human machine interface (HMI) and control software package and perform the necessary system control and data acquisition functions. It shall include communication gateway to inter- bay-bus, intelligent electronic devices (IED) for bay control and protection as shown in the enclosed general system architecture drawing.

The communication gateway shall secure control from and information flow to remote network control centers. The inter-bay bus, configured as a star connection (via star couplers) shall provide independent station-to-bay and bay-to-bay data exchange. The bay level intelligent electronic devices (IED) for protection and control shall be directly connected to the instrument transformer without any interposing equipment and perform control, protection, and monitoring functions subject to a detail proposal approved by the Engineer.

The IED's for protection and control functions shall maintain high availability and reliability together with bay independence through extensive self-supervision and state-of-the-art technology. The system shall be capable of having its computing power increased in the future by the addition of additional computing systems.

The system design life shall be not less than 20 years. The Automation system shall be from USA/UK/EU/Canada/Japan/Switzerland.

The bidder shall provide-

- i. IEC 61850 compliance report for the offered system with IEDs
- ii. Interoperability test report for the offered system with ABB, Siemens, Alstom and SEL IEDs with IEC 61850 protocol from any UCA approved system verification and validation center along with the bid document.

The capacity of the SA system shall be sufficient for the ultimate development of the substation as set out in the project requirements.

The SA supplier shall demonstrate that the system proposed has been designed, installed and commissioned in accordance with relevant international standards and the specification shall provide evidence of satisfactory service experience during the past 5 years.

The contractor shall provide the installation software for the substation automation system. Installation, testing and commissioning of substation automation system shall be done by the automation Engineer(s) of the substation automation manufacturer(s).

The software architecture and the database structure shall be finalized with the Purchaser. The facilities shall be incorporated in order to access the database from the backend by the authorized user of the Purchaser. Object-oriented technology shall be used in software development.

The Source Codes of the software standard documentation shall be handed over to the Purchaser. The standard database like Oracle, MySQL, SQL shall be used.

Cyber Security of this system shall be built in with the system. The objective of cyber security is to protect information and physical assets from damage caused by theft, corruption or natural disasters while allowing the information and assets to remain accessible and productive to employers. All potential causes of cyber-attacks need to be considered when employing a defence in depth approach.

Compliance With Standards

For design and type testing of the protection and control equipment, the following standards shall be applicable:

General List of Specifications

Specification Code	Description
IEC255	Electrical Relays
IEC60038	IEC Standard voltages

IEC68068	Environmental testing
IEC60664	Insulation co-ordination for equipment within low-voltage systems
IEC61850	Standard for Substation integrated protection and control data communication

Detailed List of Specifications

Specification Code	Description
IEC255-6	Measuring relays and protection equipment
IEC255-7	Test and measurement procedures for electromechanical all-or-nothing relays
IEC68-2-3	Test Ca: Damp heat steady state
IEC68-2-30	Test D band guidance; Damp heat, cyclic
IEC255-5	Insulation tests for electrical relays
IEC255-22	Electrical disturbance tests for measuring relays and protection equipment:
IEC255-22-1	1 MHz burst disturbance test
IEC255-22-2	Electrostatic discharge test
IEC255-22-3	Radiated electromagnetic field disturbance test
IEC255-22-4	Fast transient disturbance test
IEC255-11	Interruptions to and alternating component (ripple) in D.C. auxiliary energizing quantity to measuring relays
IEC255-6	Measuring relays and protection equipment
IEC255-21	Vibration, shock, bump and seismic tests on measuring relays and protection equipment:
IEC255-21-1	Vibration tests (sinusoidal)
IEC255-21-2	Shock and bump tests
IEC255-21-3	Seismic tests
IEC255-0-20	Contact performance of electrical relays
IEC870-3/class2	Digital I/O, Analogue I/O dielectric tests
IEC801-5/class3	Digital I/O Surge withstand test
IEC870-3/class2	Radio interference test
IEC801-4/4	Transient fast burst test

IEC801-2/4	Static discharge
IEC801-3/3	Electromagnetic fields

Design And Operating Requirements

General

The SA (Substation Automation) shall be suitable for the operation and monitoring of the complete substation including future extensions. The offered products shall be suitable for efficient and reliable operation and maintenance support of the substations.

The SA system shall be state-of-the art design suitable for operation in high voltage substation environment, follow the latest engineering practice, ensure long term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

Protection is an integral part of the SA system and protective relays shall be directly connected to the interbay bus in order to provide unrestricted access to all data and information stored in the relays and for changing protection parameters from the remote-control location.

Failure behavior of the hardware and software functions shall be addressed and related diagnostic and rectification working instructions shall be provided. The system performance, if failure of communication to main and redundant computer-based workstations, central functions, data model, control and protection IED's, station and bay level communication shall also be clearly addressed (shall be provided by the manufacturer).

The substation can also be controlled by the Local Control Panel. The following modes of operation shall be possible.

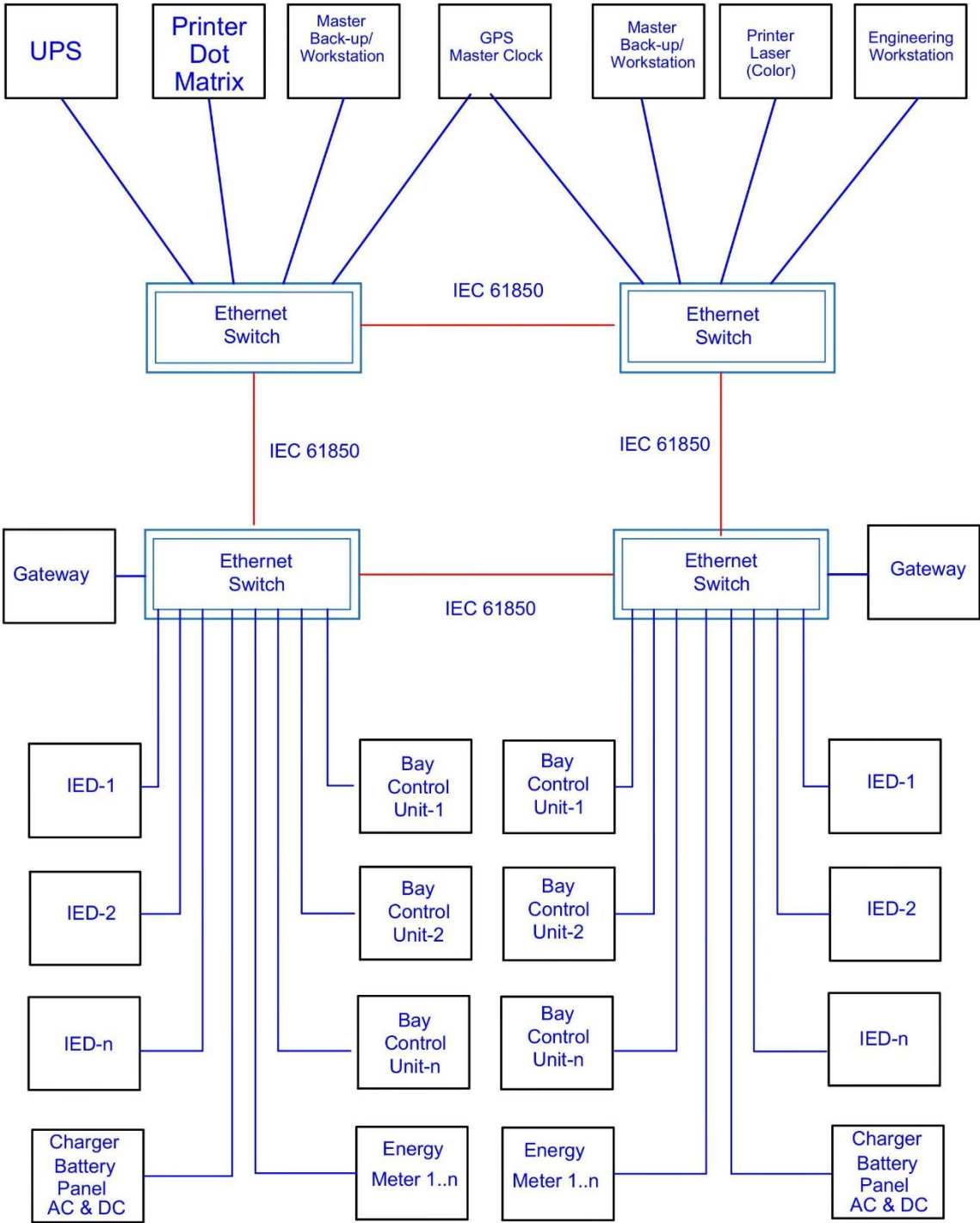
Emergency operation of breaker, disconnector, earthing switch etc. from the Local Panel. Emergency operation of breaker, disconnector, earthing switch etc. from the backup mimic panel located in the control room on the 1st floor/Ground floor. Both bay controller guided and unguided operation shall be possible from this panel.

Normal operation of breaker, disconnector, earthing switch etc. from the Station Automation System HMI located in the 1st floor/Ground floor.

The SAS architecture provided is for indication purpose only. Signal list is to be submitted by the contractor which will be finalised and approved by BREB.

SAS Architecture (Indicative)

Note: SAS Architecture will be finalized at Design Approval Stage.



Modes Of Operation

The operator stations and specified remote users shall have the following operational modes, each password protected. Monitoring Ability to select graphic displays and lists for viewing only. No capability to acknowledge alarms, complete controls or select items for inclusion in program functions.

Control: Selection of graphic display and lists. Able to acknowledge station and SA alarms, complete controls, dressing etc. associate with normal real time of the control of the substation.

SA Engineering: Provides all the SA monitoring functions, together with online facilities for program/database/format modifications and checking without the possibility of executing power system controls.

System Manager: Provides access to all system functions, including assignment of passwords and system maintenance activities.

In addition, a facility to provide access to the numerical Protection relays, change / modify relay settings & AVR parameters and Fault Recorder data shall be provided

A series of passwords shall be personally assigned to operators in each of the above categories.

It shall be possible for substation operators to log on to either of the substation workstation and to be allocated the appropriate mode of operation relevant to the password. SA System Engineering work and access to the protection relay and disturbance reorder information shall generally be carried out at the Engineering workstation or remote master station.

All the workstation and the system database shall function as a system. It shall not be necessary for example to acknowledge an alarm at more than one workstation.

Similarly, an operator manual entry applied at a workstation shall be immediately displayed at other workstations where this data is presented.

Project Specifications

Specific functions required and boundary conditions of the SA are detailed elsewhere in this specification. The project specific drawings are attached:

- i. Overall single line diagram
- ii. General system architecture
- iii. Location of substation buildings
- iv. Control and operation principles
- v. Protection schemes

Vendor's Experience and Local Support

Only experienced and technically capable manufacturers with minimum 5 years' experience in design and supply of control and protection systems for electricity transmission and distribution utility in Bangladesh applications will be accepted. The preferred manufactures will be those who have experience in deliveries of the full scope of station automation systems and services. This experience has to be substantiated by means of reference installations being in service under similar environmental conditions for at least 5 years. Local assembly or engineering of SAS from Bangladesh is not accepted. All SAS-related design, engineering, and Factory Acceptance Testing (FAT) must be conducted by factory engineers in the EU, USA, Japan, or Canada. Local engineering is not accepted. In order to assess the vendor's experience with similar projects, the vendor is required to submit the following with his Bid:

- i. Technical design specifications and description of SA
- ii. Catalogues and brochures of equipment and devices offered.
- iii. Reference list
- iv. The vendor shall ensure long-term maintenance and availability of spares. Moreover, a guarantee shall be submitted for the availability of spares during the lifetime of the SA equipment (not less than 10 years).

General System Design

The system shall be so designed that personnel without any background in microprocessor-based technology can operate the system easily after they have been provided with some basic training. System control from the substation control room will be with the help of an Industrial Computer (PC) operated by a mouse. The following HMI (Human Machine Interface) functions shall be provided:

- a) Acquisition and plausibility check of switchgear status
- b) Control of switchgear
- c) Remote checking of device parameters and activation of alternative parameter sets in the connected protective relays
- d) Display of actual measured values (U, I, P, Q, f, PF)
- e) Display of Energy (kWh and kVarh export and import)
- f) Display of events
- g) Display of alarms
- h) Display of trends
- i) Sequence control functions
- j) Disturbance records and fault location
- k) System self-supervision
- l) Hard copy printing

Maintenance, modification or extension of components shall not require a shutdown of the whole station automation system. Self-monitoring of single components, modules and communication shall be incorporated to increase the availability of the equipment while minimizing maintenance time to repair.

The data exchange between the electronic devices shall take place via an inter-bay bus using IEC 61850 protocol. The high-speed bus shall permit peer-to-peer communication between the connected devices with democratic access. The entire station shall be controlled and supervised from the station level PC. It shall also be possible to control, monitor and protect each individual bay from the respective bay level equipment for maintenance purposes or if communication to a particular bay should fail. Clear control priorities shall prevent initiation of operation of a single switch at the same time from more than one of the various control levels viz., station level, bay level or switchgear (apparatus) level. The priority shall always be with the lowest enabled control level.

Each bay control and protection unit shall be independent of each other, and its functioning shall not be affected by any fault occurring in any of the other bay control and protection units of the station.

The SAS shall contain the following main functional parts:

- a) Human Machine Interface (HMI) with process database.
- b) Gateway function for remote control via an industrial grade hardware.
- c) Dial in facility/laptop workstation for protection relay parameterization, disturbance analysis and d. SA system fault analysis.
- d) Data exchange between the different system components via high-speed bus.

- e) Bay level devices for control, monitoring and protection.
- f) Bay oriented local control and protection panels with mimic inserts.
- g) Facility for emergency operation of all the switchgear, if bay controller fails. (Key/ master key system.)

The main process information of the station shall be stored in distributed databases. The system shall be based on a de-centralized concept with bay oriented distributed intelligence for safety and availability reasons. Functions shall be decentralized, object oriented and located as close as possible to the process.

The substation monitoring/protection system shall supply data for maintenance, repair and remote parameter setting of protection and control devices in the switchyard.

In the event of a fault in the electrical network, the substation monitoring shall provide a quick means for collecting the relevant and critical data of the fault.

The monitoring system shall be suitable for the supervision and monitoring of all the secondary (IED) and primary devices in a substation including future extensions.

Maintenance, modification or extension of components shall not cause a shut-off of the whole station monitoring system. Self-monitoring of single components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

It shall be possible to access all protection and control devices for reading the terminal parameters (settings). The setting of parameters or activation of parameter sets shall be restricted by password to the protection engineer.

Flexibility and Scalability

The offered SA system concept shall be flexible and shall permit future extensions to be realized easily. Preference will be given to those suppliers who are in a position to provide protection and control devices which can be freely adapted to the application functions required.

System Hardware

Operator Station

The main operator station shall be based on industrial PC hardware and high-resolution full- graphics screen with manufacturers standard type tested software operating under Windows NT environment. An Event printer and a Hard Copy printer shall be connected via a printer server and LAN to the operator station. The CPU shall be installed in the automation panel.

Station computers shall control the SA system and drive the workstations and other peripherals.

Disturbance Records shall be analyzed using the installed Disturbance Record Analysis programs. The Disturbance Records will be collected over the interbay bus, from the connected IED's by the system software. All necessary facilities shall be provided to allow the system to perform spontaneous upload of Disturbance data or upload them in a pre-scheduled manner. The Event printer shall print events spontaneously as they arrive at the main operator station.

Each uploaded data report file shall be reported on one line that shall contain:

- a) The event date and time

- b) The name of the event object
- c) A descriptive text
- d) The state or value of the object

The information fields above shall be structured in columns for maximum readability.

The hard copy printer shall permit printing of any picture (or part thereof) from the station level PC's using easily accessible commands from the window menus.

The main Station PC's shall be supplied by the station DC battery and a UPS system with a supply duration of not less than 30 minutes shall be provided to supply the monitor and the printers. Station PC's will be supplied from the DC battery when UPS is unavailable. Necessary arrangements will be made by the bidder.

Station Inter-Bay Bus

The LAN connecting the industrial computer-based operator workstations, printers shall be Ethernet 802.3 LAN, Protocol TCP/IP (10 M.bits/ sec or higher) and the physical medium shall be thin Ethernet or fiber optic bus, provided this LAN is kept within the confines of the control room. The bay control and protection units shall be connected via glass fiber optic cables to a station inter- bay bus, operating on high speed bus, via star couplers. The star coupler shall permit the data exchange between the different system components. Glass Fiber optic connections are used in order to avoid EMI in the switchgear and substation environment.

All protection and control units with serial communication facilities are connected in a star topology via glass fiber optics to the star coupler. Under no circumstances shall events from the protections be taken into the system via bay control unit hardware i.e., each protection device should have its own independent fiber optic communication channel to the star coupler. The star couplers shall be mounted in a separate communication cubicle.

Software Structure

The software package shall be structured according to the SA architecture and strictly divided in various levels. It shall be possible to extend the station with the minimum possible effort. Maintenance, modification or extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

Confirmation that the software programs will be supported for a minimum of 20 years is required to be submitted with the Bid. The licence provided for all kind of software related to SAS must be lifetime duration.

It shall be the responsibility of the contractor to obtain any license required for the operation software. The contractor shall indemnify the client against all claims of infringement of any patent, registered design, copyright, trademark or trade name or other intellectual property right.

Station Level Software

Human Machine Interface (HMI)

The base HMI software package for the operator station shall include the main SA functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. The System shall contain a library with standard functions and applications.

Operating System

Windows operating system shall be used for the operator station as it supports several standard system features, e.g support for several Windows office applications, multitasking, security levels, data exchange mechanisms (DDE, OLE), open data base communication standards (ODBC) and a standardized, user-friendly look & feel HMI. The licensed copy of the operating system backup software shall be provided.

Bay Level Software

System Software

The system software shall be structured in various levels. This software shall be placed in a non- volatile memory. Its lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage.

Application Software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They shall form part of a library. The application software within the control/protective devices shall be programmed in a functional block language.

System Testing

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's, applicable Type Test certificates shall be submitted. FAT should be conducted by concern factory engineer in EU/USA/JAPAN /CANADA. Local engineering is not accepted.

The manufacturing phase of the SA shall be concluded by a Factory Acceptance Test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified with site conditions simulated to the extent possible in a test lab. If the FAT involves only a certain portion of the system for practical reasons, it has to be assured that this test configuration contains at least one unit of each, and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers, the supplier shall arrange interoperability test at factory during stage inspection or FAT. The complete system test shall also be performed at site in the Site Acceptance Test (SAT).

System Functions

Control Unit Functions

CONTROL

The different high voltage apparatuses within the station shall either be operated manually by the operator or automatically by programmed switching sequences.

The control function shall comprise:

- a) Commands from different operator places, e.g. from the station HMI, or local control panel according to the operating principle
- b) Select before executing commands

- c) Operation from only one operator place at a time.
- d) Operation depending on conditions from other functions, such as interlocking, synchro check, operator mode, or external status conditions.

The control function shall also include:

- a) Prevention of double operation
- b) Command supervision
- c) Selection of operator place
- d) Block/deblock of operation
- e) Block/deblock of updating of position indications
- f) Manual setting of position indications
- g) Overriding of the interlocking function (Second key switch)
- h) Switchgear run time supervision

Status Supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, etc., shall be permanently supervised. Every detected change of position shall be immediately visible on the screen in the single-line diagram, recorded in the event list, and a hard copy printout shall be produced. Alarms shall be initiated in cases when spontaneous position changes have taken place.

Each position of an apparatus shall be indicated using two binary auxiliaries normally closed (NC) and normally open (NO) contacts. An alarm shall be initiated if these position indications are inconsistent or indicate an excessive running time of the operating mechanism to change position.

Interlocking

The interlocking function prevents unsafe operation of apparatuses such as isolators and earthing switches within a bay or station wide. The operation of the switchgear shall only be possible when certain conditions are fulfilled. The interlocking function is required to be decentralized so that it does not depend on a central control device. Communication between the various bays for the station interlocking shall take place via bay communication system. An override function shall be provided, which can be enabled to bypass the interlocking function via a key/password, in cases of maintenance or emergency situations.

Measurements

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The correlated values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated.

Event And Alarm Handling

Events and alarms shall be generated either by the switchgear, by the control devices and by the station level unit. They shall be recorded on an event list in station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time tagged with a time resolution of 1ms. The time tagging shall be done at the lowest level where the event occurs, and the information shall be distributed with the time tagging.

Time Synchronization

The time within the SA shall be set via a GPS Clock Receiver connected directly to the Bay Level LAN. The time shall then be distributed to the control/protective devices via the high-speed optic fiber bus. An accuracy of ± 1 ms within the station is required.

Synchronism And Energizing Check

The synchronism and energizing check functions shall be distributed to the control and/or protective devices and shall have the following features:

- a) Adjustable voltage, phase angle, and frequency difference.
- b) Energizing for deadline - live bus, or live line - dead bus
- c) Settings for manual close command and auto-reclose command shall be adaptable to the operating times of the specific switchgear.

Voltage Selection

The voltages, which are relevant for the synchro check functions, depend on the station topology i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, isolator, and earthing switch and shall be selected automatically by the control and protection IED.

HMI Functions

General

The operator station HMI shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear via the station monitor with the help of mouse clicks on soft keys.

The HMI shall provide the operator with access to alarms and events displayed on the screen. Besides these lists on the screen, there shall be a printout of hard copies of alarms or events in an event log. The Alarm List shall indicate persisting and fleeting alarms separately. An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- a) Single line diagram showing the switching status and measured values.
- b) Control dialogues
- c) Measurement dialogues
- d) Blocking dialogues
- e) Alarm list, station / bay oriented
- f) Event list, station / bay oriented
- g) System status
- h) Checking of parameter settings

HMI Design Principles

Consistent design principles shall be provided with the HMI concerning labels, colors, dialogues and fonts. Non-valid selections shall be dimmed out.

Object status shall be indicated using different status colors for:

- a) Selected object under command

- b) Selected on the screen
- c) Not updated, obsolete value, not in use or not sampled
- d) Alarm or faulty state
- e) Warning or blocked
- f) Update blocked or manually updated
- g) Control blocked
- h) Normal state
- i) Busbar coloring to show live & dead bus

Process Status Displays and Command Procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap changers are displayed in the station single line diagram.

In order to ensure a high degree of security against unwanted operation, a special "select before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen and all other switchgear shall be blocked.

After the "execution" of the command, the operated switch symbol shall blink until the switch has reached its final new position. The system shall permit the operator to execute a command only if the selected object is not blocked and if no interlocking condition is going to be violated the interlocking conditions shall be checked by the interlocking scheme which is implemented on bay level.

After command execution, the operator shall receive confirmation that the new switching position is reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

System Supervision Display

The SA system shall feature comprehensive self-supervision such that faults are immediately indicated to the operator before they possibly develop into serious situations. Such faults are recorded as faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IED's, communication links, and printers at the station level etc.

Reports

The SA shall generate reports that provide time-related information on measured values and calculated values. The data displayed shall comprise:

Trend reports:

- a) Day (mean, peak)
- b) Month (mean, peak)
- c) Semi-annual (mean, peak)
- d) Year (mean, peak)
- e) Historical reports:
 - i. Day
 - ii. Week
 - iii. Month
 - iv. Year

It shall be possible to select displayed values from the database on-line in the process display. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

This report shall be printed automatically at pre-selected times. It shall also be possible to print this report on request.

Trend Display (Historical Data)

A trend is a time-related follow-up of process data. The analogue channels of all the connected bay level devices on the 33 kV level shall be illustrated as trends. The trends shall be displayed in graphical form as columns or curve diagrams with 10 trends per screen as maximum. It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

Event List

The event list shall contain events which are important for the control and monitoring of the substation. The time has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it. A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer. The information shall be obtainable also from printed event log.

The chronological event list shall contain:

- a) Position changes of circuit breakers, isolators and earthing devices.
- b) Indication of protective relay operations
- c) Fault signals from the switchgear
- d) Violation of upper and lower limits of analogue measured value.
- e) Loss of communication

Filters for the selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- a) Date and time.
- b) Bay
- c) Device
- d) Function
- e) Alarm class

Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control center. The alarm list shall substitute a conventional alarm tableau and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. Date and time of occurrence shall be indicated. The alarm list consists of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- a) The alarm date and time
- b) The name of the alarming object
- c) A descriptive text
- d) The acknowledgement state

The operator shall be able to acknowledge alarms, which shall be either audible or only displayed on the monitor. Acknowledged alarms shall be marked on the list. Faults that appear and disappear without being acknowledged shall be specially presented in a separate list for fleeting alarms. For example due to bad contacts or intermittent operation. Filters for selection of a certain type or group of alarms shall be available as for events.

Object Picture

When selecting an object such as a circuit breaker or isolator in the single line diagram, first the associated bay picture shall be presented. In the selected object picture, all attributes shall be displayed such as-

- type of blocking,
- authority
- local / remote control
- SA control
- errors, etc.,

Control Dialogues

The operator shall give commands to the system by means of soft keys located on the single line diagram. It shall also be possible to use the keyboard for soft key activation. Data entry is performed with the keyboard.

User Authority Levels

It shall be possible to restrict the activation of the process pictures of each object (bays, apparatus, etc.) to a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close apparatus)
- Restricted operation (e.g. by-passed interlock)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

- a) No engineering allowed
- b) Engineering/configuration allowed
- c) Entire system management allowed

The access rights shall be defined by passwords assigned during the log-in procedure. Only the system administrator shall be able to add/remove users and change access rights.

System Performance

The refresh/ update times on the operator station PC under normal and calm conditions in the substation shall be according to the levels specified below:

Functions	Typical values
Exchange of display (first reaction)	< 1s
Presentation of a binary change in the process display	< 0.5 s
Presentation of an analogue change in the process display	< 1s

From order to process output	< 0.5 s
From order to update of display	< 1.5 s

System Reliability

The SA system shall be designed to satisfy very high demands for reliability and availability concerning:

- 1) Solid mechanical and electrical design
- 2) Security against electrical interference (EMI)
- 3) High quality components and boards
- 4) Modular, well-tested hardware
- 5) Thoroughly developed and tested modular software
- 6) Easy-to-understand programming language for application programming
- 7) Detailed graphical documentation, according to IEC1131-3, of the application software
- 8) Built-in supervision and diagnostic functions
- 9) After sales service
- 10) Security
- 11) Experience of security requirements
- 12) Process know-how
- 13) Select before execute at operation
- 14) Process at user presentation as double indications
- 15) Distributed solution
- 16) Independent units connected to the local area network
- 17) Back-up functions
- 18) Panel design appropriate to the harsh electrical environment and ambient conditions.
- 19) Panel grounding to provide immunity against transient ground potential rise

Configuration Tools

The configuration of the station HMI shall be made using the operator station working in a Windows environment. The various functions shall be customized by easy-to-use interactive configuration tools. Configuration shall include the visual presentation of the object, adaptations needed in process database and adaptations of the communication configuration data.

The PC based service & support system shall be used for the following purposes:

- System configuration
- System testing
- Help functions
- Program documentation
- Down-and up-loading of programs System commissioning
- Data base management
- Changing peripheral parameters

The service & support system shall be able to monitor data in the running substation control system and to present changing variables on the display screen in graphic representation.

Information Required

The following documentation shall be provided for the system during the course of the project and they shall be consistent, CAD supported, and of similar look/feel:

- List of Drawings
- Control Room Lay-out
- Assembly Drawing
- Single Line Diagram
- Block Diagram
- Circuit Diagram
- List of Apparatus
- List of Labels
- Functional Design Specification (FDS)
- Test Specification for Factory Acceptance Test (FAT)
- Logic Diagram
- List of Signals
- Manual
- Product Manuals
- Calculation for uninterrupted power supply (UPS) dimensioning
- Licensed Copy of all software
- Third Party cyber security certification

Documentation Required

The following documents shall be submitted with the offer otherwise the bid will be rejected.

- a) Letter of authorization from the Manufacturers, in case the bidder is not the manufacturer.
- b) Manufacturer's authorization Letter for relay and other protection equipment as mentioned in the technical specification.
- c) Manufacturer's supply record for at least 3 years within the last 10 years specifically mentioning purchaser's name, address, telephone number, fax number, contract number with date, supply quantity with ratings, date of commencement & completion of supply, in format below. Supply record will be equipped with the same offered type of SAS.

Sl. No.	Name, address, phone & Fax No. of the Consumer	Contract No. & Date	Contract value	Description of materials with quantity	Date of completion of supply

- d) Satisfactory Performance certificates (SPC) issued within the last 10 years from at least 3 End users depicting that the offered type of automation system.
- e) Submission of Type Test Reports/ Certificate as stated in per relevant IEC from recognized independent laboratories.

Foreign Training:

The Contractor shall provide foreign training (In Manufacturer premises) for 14 days for 5 nos technical personnel of BREB/PBS on operation, maintenance, configuration and simulation of Substation Automation System. Printed training manual & required documents, all costs including visa fees, air fares, accommodation, fooding, laundry, transportation etc. plus daily allowance (not less than govt. rules) and any logistics support as required must be provided. Details of the training program is to be submitted by the contractor which will be finalised by the PE.

Local Training:

The Contractor shall provide Local Technical Training (In Substation) for 10 days for 10 Nos. technical Personnel of BREB/PBS for on operation, maintenance, configuration and simulation of Substation Automation System. Printed training manual & required documents, breakfast, lunch, transportation & 2000tk daily allowance for each participants must be provided.

Technical Requirement for Substation Automation System

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
Name & address of the Manufacturer	-	To be mentioned	
Country of Origin and Manufacture (Shall be the same)	-	USA/ UK/ EU/ Japan/ Canada/ Switzerland	
General Requirement:			
Communication protocol at all levels	-	IEC61850. Fully complying with the standard.	
Temperature range (min/max) Computer	° C	0 to 50	
Relative humidity	%	20 to 93 non- condensing	
System performance, interoperability and interchangeability test among ABB (Switzerland/Sweden/Finland)/ Hitachi (Switzerland/Sweden)/Siemens (Germany)/ Alstom (France/UK) and SEL(USA) IEDs done in the system verification center.	-	Yes	
All updated SCD, ICD and CID files shall be provided in portable hard drives and CD/DVD	-	YES	
Detailed Requirements			
Manufacturer of the Automation Panel		To be mentioned	
Country of Origin of the Automation Panel		USA/UK/EU/Japan/ Canada/ Switzerland	
The Automation Panel shall be from the origin of the manufacturer of the system	-	Yes	
Name of the Substation Automation System Software	-	To be mentioned	
Name and Address of the Substation Automation System Software manufacturer	-	To be mentioned	
Engineering and Assembling of the substation automation system shall be from the origin of the system		Yes	
Automation equipment Manufacturer's experience	Year	10	
Number of years of proven field experience of offered system. (Note: proof of experience should be furnished. The components used in the offered system and those with field experience should be the same)	Year	5	
Model of the Substation Automation System		To be mentioned	
Design life of Substation Automation System	Year	≥20	

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
Manufacturers quality assurance system	-	ISO 9001/9002 or equivalent	
Dimensions of cubicle	mm	To be mentioned	
Floor load	N/m ²	max. 600	
Station Level Equipment:			
Station Computer	-	Industrial PC (From Internationally Reputed Manufacturer)	
Power supply to the servers	-	230V AC from Inverter	
Operating System	-	Windows	
All standard picture as per Tspec included in HMI	-	To be provided	
Process Status Procedures	-	To be provided	
Event processing as per Tspec	-	To be provided	
Alarm processing as per Tspec	-	To be provided	
Trend Display as per Tspec	-	To be provided	
User Authority levels as per spec	-	To be provided	
System supervision & monitoring as per Tspec	-	To be provided	
Automatic sequence control as per Tspec	-	To be provided	
High quality SCD file complete with ICD files& station topology	-	To be provided	
Operator Work Station (Master/Backup workstation) shall have separately connection o different Ethernet switch		Yes	
MTBF (Mean time between Failures)	Hrs.	Shall be mentioned	
MTTR (Mean time to repair)	Hrs.	Shall be mentioned	
Dual Station Computers Provided in redundant hot standby configuration		YES	
Number of years of proven field experience of offered software	Yrs.	5	
Gateway to Central Control Room			
Name of manufacturer, Address & Country of origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Model no.	-	To be provided	
Number of years of proven field experience of offered unit	Year	5	
Insulation tests	-	As per IEC60255-5	
Fast disturbance tests	-	IEC 61000-4-4, Calss 4	
Industrial environment	-	EN50081-2ClassA	
Industrial grade hardware with no moving parts (PC-based gateway is not accepted)	-	To be provided	
Design life of offered equipment	Year	20	
Redundant communication channel	-	To be provided	

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
Redundant CPU	-	To be provided	
Redundant DC/DC Supply	-	To be provided	
MTBF (Mean time between Failures)	Hrs	To be mentioned	
MTTR (Mean time to repair)	Hrs	To be mentioned	
Station Bus:			
Connection between Ethernet switches		Glass fiber optic	
Connection between Ethernet switches and IPC, Gateway, Firewall, Printer etc.		Ethernet	
Inter bay Bus			
Physical Medium		Glass fiber optic	
Event Printer			
MTBF	Hrs	To be mentioned	
Hard Copy Colour Printer			
MTBF	Hrs	To be mentioned	
Master Clock GPS (Global Positioning System) Receiver:			
Name of the manufacturer & country of origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Manufacturer's address	-	To be mentioned	
Model		Shall be mentioned	
MTBF	Hrs.	Shall be mentioned	
Ethernet Switch			
Name of manufacturer &. address	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Model number	-	To be mentioned	
Type		Industrial Grade, rackmount	
Redundant Power supply	-	To be provided	
Ethernet switch shall have dual connection to each other.		Yes	
Communication Port		Optical with LC connector & Ethernet (Must be compatible with IED Communication Port)	
Operator Work Station (OWS)			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Type	-	Industrial PC	
Country of Manufacture	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Processor	GHz	Intel core i7/ Core Ultra 7 13th generation or latest generation	
Clock Speed	GHz	3.0 GHz (min), 30 MB Cache Memory (min)	
Bus Speed	MHz	Min. 3200 MHz or higher	
RAM	GB	16 GB, Expandable to 32 GB	

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
		(min.)	
HDD	TB	2 x 1 TB NVMe SSD (RAID)	
OS	-	Licensed windows with Software recovery kit	
Software	-	Lifetime Licensed Anti-Virus Software	
Mouse	-	Reputed Brand Wireless Optical Mouse	
Keyboard	-	Integrated standard Keyboard	
Monitor	inch	15.6", Full HD (min)	
Engineer Work Station (EWS)			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of Origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Processor	GHz	Intel Core i5 Processor, 13th generation or latest	
Clock Speed	GHz	3.0 GHz (min), 20 MB Cache Memory (min)	
Bus Speed	MHz	Min. 3200 MHz or higher	
RAM	GB	16 GB DDR4	
HDD	GB	1 TB NVMe SSD	
Mouse	-	Reputed Brand Wireless Optical Mouse	
Keyboard	-	Integrated standard Keyboard	
Monitor	inch	15.6", Full HD (min)	
OS Support	-	Windows 11 professional or latest	
OS	-	License windows with recovery kit	
Software	-	All types of configuration software with licenses for SAS and IED, Licensed Anti-Virus Software, Licensed OS & other necessary software	
Laser Color Printer			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of origin	-	To be mentioned	
Toner type	-	Toner and associated drum unit in single case, No starter toner. output tray, 250-sheet facedown output tray purpose	
Media Sizes	-	Letter, Legal, A4, A5, B5 and custom sizes	
Media Types	-	Paper (Plain, Preprinted, Letterhead, Bond, Paper (Plain Color, Recycled, Rough), Transparencies, Labels	

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
Event Printer			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of origin	-	To be mentioned	
Print Method	Pin	9 Pin Serial Impact Dot Matrix.	
Print Speed	Lps	Min. 6.0 LPS (30 Columns:16 CPI).	
Data Buffer	KB	4KB.	
Inked Ribbon	-	ERC-38(Black/Red).	
Interface	-	USB Interface, Bi- directional parallel.	
System Performance:			
Exchange of display (First reaction)	Sec	<1	
Presentation of a binary change in the Process display	Sec	< 0.5	
Presentation of an analogue change in the process display	Sec	<1	
From order to process output	Sec	< 0.5	
From order to updated of display	Sec	< 1.5	
Protocol Converter / IO module, if required			
Brand	-	To be mentioned	
Model	-	To be mentioned	
Country of Manufacturer	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Detail Signaling & Interlocking system		To be included	
Firewall			
Name of Manufacturer		To be mentioned	
Brand		To be mentioned	
Model/Type		To be mentioned	
Origin		USA/UK/EU/Japan/ Canada/ Switzerland	
IP Filtering Port Filtering MAC Filtering Port Forwarding DMZ Denial of Service NAT Mapping		To be provided	
Packet throughput of at least 150 Mbps		To be mentioned	
3DES Encryption throughput of 20 Mbps		To be mentioned	
Support for 200 VPNs		To be mentioned	
Maximum concurrent sessions, with AVC		To be mentioned	
Maximum new connections per second, with AVC		To be mentioned	
Local On-device Management		Yes	
Application Visibility and Control (AVC)		Standard	

DESCRIPTION	Unit	BREB's Requirement	Guaranteed Particulars
Security Intelligence		Standard, with IP, URL, and DNS threat intelligence	
List (Name & version) of all types of software required for SAS configuration, operation, monitoring and Remote control individually for Both OWS and EWS		To be mentioned	
Others Requirement			
All Licenses required for the system including future SCADA connection with physical communication port ready installed		To be provided as per requirement of employer	
The Communication device shall support for future SCADA connection		IEC 60870-5-104	
Facility for measuring SAIDI SAIFI		To be included	
The licence provided for all kind of software related to SAS must be lifetime duration.			

TECHNICAL SPECIFICATION FOR DEMO SUBSTATION AUTOMATION SYSTEM

1. SCOPE OF WORK

The scope includes design, engineering, manufacturing, supply, installation, testing, commissioning, and training of a Demo Substation Automation System (SAS) based on IEC 61850 standard for educational and demonstration purposes.

The system shall simulate a typical substation automation architecture including but not limited to:

- Protection relays (IEDs)
- Bay Control Unit (BCU)
- Ethernet communication network
- SCADA/HMI workstation
- CT/VT simulation module
- Circuit breaker simulation
- Control & mimic panel
- Master Trip Relay
- RTU
- Multifunction Meter

IED, HMI Software and Gateway should be from the same manufacturer.

2. SYSTEM ARCHITECTURE

The system shall be a three-level architecture:

2.1 Process Level

- CT Simulator
- VT Simulator
- Breaker Simulator with trip/close indication
- Status feedback contacts
- Local/ Remote Switch
- TNC Switch
- DS & ES Simulator

2.2 Bay Level

- Minimum 1 Nos. Numerical Protection Relays (IED)
- 1 No. Bay Control Unit (BCU)
- Digital & Analog I/O interface
- 1 nos Multifunction Meter

2.3 Station Level

- Industrial Ethernet Switch (Managed)
- SCADA/HMI Workstation
- Engineering & Configuration Software

Communication protocol: IEC 61850 (GOOSE + MMS) over Ethernet, Modbus.

Panel shall be easily moveable. Panel should have the provision to connect loose relays via harting cable.

3. TECHNICAL REQUIREMENTS

3.1 Protection Relays (IED)

- Type: Numerical Multifunction Relay
 - Protection Functions:
 - Overcurrent (50/51)
 - Earth Fault (50N/51N)
 - Communication: IEC 61850 Edition 2
 - Optical/ Electrical Ports: Minimum 2
 - Event Recording: Available
 - Disturbance Recorder: Available
 - Time Synchronization: SNTP / IRIG-B
 - Mounting: Flush / Semi-flush panel
-

3.2 Bay Control Unit (BCU)

- Digital Inputs: Minimum 8
 - Digital Outputs: Minimum 6
 - Local/Remote breaker control
 - IEC 61850 compatible
 - LED indication for status
-

3.3 Remote Terminal Unit (RTU)

3.3.1 General

The Demo Substation Automation System shall include one (1) Remote Terminal Unit (RTU) for demonstration of:

- SCADA remote communication
- Protocol conversion
- Control center simulation
- Legacy system integration

The RTU shall function as a gateway between IEC 61850-based SAS and remote SCADA protocol (IEC 60870-5-104 / DNP3). HMI Workstation & RTU (Gateway) should be independent of each other & physically separate device. Failure of one device should not affect operation of the other device & vice-versa.

3.3.2 Functional Requirements

The RTU shall:

- Collect digital and analog signals from IEDs/BCU

- Communicate with SAS via IEC 61850
 - Convert data to IEC 60870-5-104 or DNP3
 - Transmit data to simulated remote control center
 - Receive remote control commands
 - Provide time synchronization support
-

3.4 SCADA / HMI Workstation

- Industrial PC (Laptop)
- Windows-based SCADA software
- Features:
 - Single Line Diagram (SLD)
 - Alarm handling
 - Event log
 - Data logging
 - Report generation
 - IEC 61850 client functionality
 - Engineering configuration tool included
 - Display Monitor (Minimum 55 inch)

HMI Software should be manufactured by the Manufacturer itself, No third party software is acceptable.

3.5 Demo Panel

- Type: Floor mounted with wheel
 - Mimic diagram of substation
 - Indication lamps for breaker status
 - Proper ferruled wiring
 - Terminal blocks labeled
 - Banana Plug Sockets
-

4. POWER SUPPLY

- Proper MCB protection for all circuits
-

5. TESTING & COMMISSIONING

Vendor shall perform:

- IEC 61850 communication testing
 - Fault simulation demonstration
 - Breaker trip logic testing
-

6. TRAINING REQUIREMENT

Vendor shall provide minimum:

- 10 days hands-on training for 7 nos BREB/PBS engineers on SAS Software Simulation Configuration.
 - Training shall be based on vendor's Substation Automation System.
 - Details of the training program shall be finalized by the Procuring Entity.
 - Training manual (soft & hard copy).
 - Relay configuration guide.
 - BDT 2000 shall be provided as training allowance per day to training participants.
 - Snacks and lunch shall be provided.
-

7. DOCUMENTATION

The following documents shall be provided:

- Single Line Diagram (SLD)
 - System Architecture Diagram
 - Wiring Diagram
 - I/O List
 - GTP (Guaranteed Technical Particulars)
 - Operation & Maintenance Manual of vendor's SAS
 - Software license certificates
-

8. WARRANTY

- Minimum 12 months warranty from commissioning date.
- Support for configuration and troubleshooting during warranty period.

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
DEMO SUBSTATION AUTOMATION SYSTEM**

SI No	Parameter	Required Specification	Tenderers Guaranteed Values
1	Manufacturer Name & Address	To be mentioned	
2	Model Name	To be mentioned	
	Protection Relay (IED)		
3	Type	Numerical Multifunction Relay	
4	Manufacturer's Name & Country	ABB (Finland)/ Siemens (Germany)/ GE (USA/ UK)	
5	Model	To be mentioned	
6	Communication Protocol	IEC 61850	
	Bay Control Unit (BCU)		
7	Manufacturer's Name & Country	ABB (Finland)/ Siemens (Germany)/ GE (USA/ UK)	
8	Model	To be mentioned	
9	Communication	IEC 61850 Compatible	
	SCADA / HMI Workstation		
10	Software Compatibility	IEC 61850 Client	
11	Functions	SLD, Alarm, Event Log, Data Logging	
12	Report Generation	Required	
13	List of licensed Software and model	To be mentioned	
	CT/VT Simulator		
14	Fault Simulation	Phase & Earth Fault	
15	Remote Terminal Unit (RTU)		
16	Type	Industrial RTU/Gateway	
17	IEC 61850 Support	Client	
18	IEC 60870-5-104	Server	
19	DNP3	Optional	
	Master Trip Relay		
20	Manufacturer's Name and Country	To be mentioned	
21	Model	To be mentioned	
	Multifunction Meter		
22	Manufacturer's Name and Country	To be mentioned	
23	Model	To be mentioned	
	RTU		
24	Manufacturer's Name & Country	To be mentioned	
25	Model	To be mentioned	
26	In-built Firewall Functionality	To be provided	
	Laptop		
27	Manufacturer Name	To be mentioned	

SI No	Parameter	Required Specification	Tenderers Guaranteed Values
	Monitor		
28	Manufacturer Name	To be mentioned	
	Demo Panel		
29	Mimic Diagram	Required	
30	Wiring	Ferruled & Tagged	

SUBSTATION BATTERY AND BATTERY CHARGER

The following battery size is the minimum expected and is provided as a guide only. The Contractor shall provide the detailed calculations of the loads and the expected loadings and the sizing of the battery for approval before implementation. The number of cells required in the battery shall be determined by the Contractor in accordance with the design of the DC requirements.

A. BATTERY

i	Application	: Supply for remote control, operation, indication, protective and regulation apparatus, emergency light etc.
ii	Installation	: Indoor (self-supporting unit).
iii	Type/Model	: Nickel Cadmium Alkaline
iv	Operating Voltage	: 110 V, DC
v	Continuous discharge Rate	: 10 hours
vi	Capacity (at the 10 hr rate)	: 250 A hour
vii	No. of cells	: 92
viii	Discharging voltage	: 1.1 - 1.7 volt per cell
ix	Charging voltage (normal)	: 1.45 - 1.55 volt per
x	Charging voltage (max)	: 1.70 volts per cell
xi	Type of container	: Transparent plastic
xii	Mounting	: Cabinet
xiii	Construction	: Closed top
xiv	Standard	: All equipment and materials shall be designed, manufactured and tested in accordance with the latest editions of applicable IEC standard unless otherwise specified in the specification. Other internationally acceptable standards will also be considered provided that relevant values are at least similar to those under IEC standards.

Features and Accessories:

The battery shall be Nickel Cadmium Alkaline type, negative plates shall have life equal to or greater than positive plates.

The battery shall have built in protection against active materials shedding and grid corrosion and shall be assembled in heat-resistant, shock-absorbing containers. The containers and covers shall be connected together to form a leak proof bond against seepage of electrolyte.

The cell terminal posts of the inter-cell and end cell connectors shall have adequate current carrying capacity and shall be of lead alloy or lead alloy reinforced with copper inserter. The container shall be filled with sufficient quantity of Alkaline complying with internationally acceptable standards to ensure that the surface of Alkali is leveled with the level mark.

Cells shall be equipped with necessary bolts and alkali resisting units, shall be furnished with all the bolts.

Plates shall be hung suspended without touching the bottom of the containers. Containers shall provide sufficient sediment space so that the plates in the cell, as well as to avoid cleaning of cells during the expected life of the battery.

110% of the required electrolyte meeting the manufacturer's specification shall be supplied at the correct filling specific gravity with each battery. The electrolyte shall be packaged in 15 gallons or less plastic coated steel drum or in plastic containers. After discharging off the specified rated capacity, the battery shall have the voltage including the internal resistance drip of all inter cell and inter rack connectors not to drop below 1.10 VPC.

The battery rack shall be a few step structural steel and shall be painted with 2 coats of acid resistant Grey paint. Inter rack connector terminal lugs shall be provided with each rack.

Battery shall be shipped dry with concentrated electrolyte in separate containers.

The following accessories shall be supplied with each battery set:

Two lead plated lugs for No. 4/0 AWG copper cable. Two portable hydrometer syringe.

One set of socket wrenches to fit nuts.

Polyethylene bottle with extendable tube for topping up the battery. Special voltmeters to measure cell voltage.

One gallon of anti-corrosive paint.

The following spare parts shall be supplied with each battery set:

One positive plate

One negative plate

One spare container and cover. One vent plug

One gallon electrolyte.

The battery shall be tropicalized.

All other features as stated in the table of guaranteed data schedule shall be applicable also.

B. BATTERY CHARGER**1. GENERAL****1.1 Scope**

This Standard Specification stipulates the requirements for the supply of spare 110 Volt DC Three Phase 70 A Float Cum Boost Charger (FCBC) with Diode Voltage Regulator (DVR) Battery Charger. This battery charger should be capable to charge the battery bank and supply (110V DC) for the substation DC network.

1.1 Standards

The battery charger equipment shall be designed in compliance with the following International Electro-technical Commission (IEC) Standards:-

IEC 60146-1-1: Semiconductor converters

1.2 Site Operating Conditions

1.3.1 Site Condition

- (a) Maximum altitude above sea level: 1000m
- (b) Maximum ambient temperature: 50°C
- (c) Minimum ambient temperature: 0 °C
- (d) Average yearly temperature: 30 °C
- (e) Maximum relative humidity: 98 %

1.3.3 Indicative Dimensions of Existing Battery Charger:

Existing battery charger panel dimension (approximate)

Width: 800±5mm

Height: 2100±10mm

Depth: 800±5mm

2. BATTERY CHARGER

General

Scope

This Standard Specification stipulates the requirements for the supply of spare 110 Volt DC Three Phase 70 A Float Cum Boost Charger (FCBC) with Diode Voltage Regulator (DVR) Battery Charger. This battery charger should be capable to charge the battery bank and supply (110V DC) for the substation DC network.

Standards

The battery charger equipment shall be designed in compliance with the following International Electro-technical Commission (IEC) Standards:- IEC 60146-1-1: Semiconductor converters

Site Operating Conditions

Site Condition:

- a) Maximum altitude above sea level: 1000m
- b) Maximum ambient temperature: 50°C
- c) Minimum ambient temperature: 0°C
- d) Average yearly temperature: 30°C
- e) Maximum relative humidity: 98 %

Indicative Dimensions of Existing Battery Charger:

Existing battery charger panel dimension (approximate):

Width: 800±5mm

Height: 2100±10mm

Depth: 800±5mm

Battery Charger

General

The battery charge shall be of solid state type and shall comprise a power supply transformer, rectifiers, float and boost control alarm detection equipment output load Voltage control equipment and accessories.

Rating

The battery charger shall have both boost and float charge modes. In either mode the charger shall supply the rated load in addition to the battery charging duty.

The charger shall have constant Voltage and output, with current limiting feature to prevent excessive charging and to optimize the service life of the battery.

Technical Requirement

- a) AC input voltage: 415V, 3 Phase, 4 wire, permissible variation $\pm 15\%$
- b) AC input frequency: 50 Hz, permissible variation $\pm 5\%$
- c) DC output voltage settings:
 - Nominal: 110 V DC
 - Float: 126 V DC (adjustable) (1.4V/cell)
 - Boost: 153 V DC (adjustable) (1.7V/cell)
- d) Total continuous current: minimum 70A
Battery Charging current: 50A
- e) Power Conversion: AC to DC by means of a three phase full wave full Controlled bridge consisting of Thy-Thy modules
- f) Output Voltage Regulation: $\pm 1\%$ of set voltage for $\pm 15\%$ input variations and 0-100% load variations
- g) Switchgear:
 - Input side: Input ON/OFF MCB
 - Output side: Output ON/OFF MCB
 - Battery side: Switch+ Fuse in battery path
- h) Meters (Digital Type):
 - Input Voltmeter : 0-750 V AC (with selector switch)
 - Output Voltmeter : 0-200 V DC
 - Load Voltmeter : 0-200 V DC
 - Output Ammeter : 0-100 A DC (with Ext. Shunt)
 - Battery Voltmeter : 0-200 V DC
 - Battery Ammeter : 100-0-100A, DC (Ext. Shunt)
 - Earth leakage Ammeter : 100-0-100 mA
- i) Operating Temperature : 0-50°C
- j) DVR: Diode voltage regulator is provided to maintain the load voltage within $\pm 10\%$ (i.e range 99V to 121V) of normal voltage in either mode (Boost mode) of the operation.
- k) Cooling: Natural air cooling for ventilation
- l) Insulation break down voltage: 2kV for 1min.
- m) Cable Entry: Bottom. Ferrules will be provided at both ends of each wire for identification

Charger Control

The load voltage shall be kept within the range of 90%-110% nominal over a load range of 0-100%. Automatic voltage controlling devices (e.g. Series dropper diodes) shall be provided to maintain the load voltage within this specified range. Suitable time-delay shall be incorporated to prevent the operation of such controllers during a switching duty cycle or a switching transient situation.

The charger output voltage shall be maintained within $\pm 1\%$ of present voltage irrespective of $\pm 15\%$ mains voltage variation $\pm 5\%$ frequency variation or 0-100% load current variation.

The charger output voltages and current limits shall be independently adjustable but preset at the manufacturer's works to suit the battery supplied. The charge voltage range shall be adjustable between 100-140% of nominal battery voltage. The current limit shall be adjustable between 40-100% of rated charger output.

FCBC provided with an auto/manual selection push/ touch button and FLOAT/BOOST selection push/touch button through keypad on the front door of the panel with password protection for each four (4) modes of operation mentioned below:-

- In auto float mode, the charger operates in float mode if the battery current is less than the battery current limit, then the charger will go to the boost mode automatically.
- In auto boost mode, the charger maintains a constant set value of boost voltage. If the battery draws more than battery current limit value, then the voltage is dropped and maintains a constant battery current. In this case if boosting charging is completed, the charger will revert back to float mode automatically for their normal operation.
- In manual float mode, the charger is selected to operate in manual float mode by using front panel keys (auto/manual and float/boost keys), by selecting the manually. Then the charger is operated in float mode respective of battery current. During this mode it maintains of float voltage.
- In manual boost mode, the charger is selected to operate in manual boost mode by using front panel keys (Auto/Manual and float/Boost keys) by selecting them manually. Then the charger is operated in boost mode irrespective of battery current. During this mode it maintains set value of boost voltage. In this case if boosting charging is completed (by means of time, charger will revert back to float mood automatically for their normal operation).
- Under normal condition the charger supply the voltage to load by trickle charging the battery In case of mains failure under normal condition the battery will start supplying the load without any interruption.
- Upon resumption of AC mains power the charger develops voltage and resume normal operation of supplying load and float charging the battery. However the battery may have been discharged and needs boosting charging. Hence FCBC will go to the boost mode automatically in case of charger is in auto mood. After completion of boost charging (battery full charged) FCBC will come back to float mode and reconnects the load. FCBC will revert back to float mood based on their condition of the boost time setting or battery current limit setting.

Charger Protective Equipment

1. General

Unless otherwise specified, the load shall not be disconnected from the battery in the event of a failure of the mains supply, the battery or the charger.

Current limiting circuitry shall be incorporated into both the boost charger and the float charger to prevent damage to the chargers or the battery, in case of a short-circuit, overload or accidental polarity reversal.

An earth leakage detector shall be provided for the 110V D.C. Battery to detect the current leakage from either the positive or the negative terminal.

HBC fuses shall be provided at the mains input and at the charger output. Each fuse holder shall be provided with a label indicating the fuse rated current and application. The charger shall be tripped from a normally closed contact upon detection of failure of battery room ventilation by a sensor supplied by others.

The charger should have also the protection Surge suppressors, soft start feature, total current limit and short circuit, rectifier protection fuse, blocking diode, control circuit and voltmeter fuse, control cards (each) temperature protection.

2. Alarms

Devices for detecting the following alarm conditions and initiating visual display shall be provided.

- (a) Mains failed (in case of a 3-phase charge, failure of one phase shall initiate alarm).
- (b) Fan failed (Where installed).
- (c) Charger temperature high.
- (d) Charger output over voltage.
- (e) Changer output under voltage.
- (f) Load supply under voltage.
- (g) Load supply over voltage.
- (h) Charger phase imbalance.
- (i) Earth leakage (where installed).
- (j) Phase sequence fail.
- (k) Charger fail.
- (l) Charger overload
- (m) Battery under voltage
- (n) Battery over voltage
- (o) Battery MCB trip
- (p) Firing card fail

3. Monitoring and Control Equipment

- (a) Mains ON/OFF switch (key lockable);
- (b) BOOST/FLOAT charge manual selector or pushbutton (key operated);
- (c) Ammeter, charger output;
- (d) Ammeter, battery load;
- (e) Voltmeter, charger output;
- (f) Voltmeter, load output;
- (g) LED type indicating lamps:
 - (i) Mains failed (red)
 - (ii) Earth leakage (where installed) (red)
 - (iii) Electrolyte level low (where installed) (red)
 - (iv) Charger failed (red)
 - (v) Fan failed (where installed) (red)
 - (vi) Charger temperature high (red)
 - (vii) Battery temperature high (red)
 - (viii) Charger voltage low (red)
 - (ix) Charger voltage low (red)
 - (x) Load voltage high (red)
 - (xi) Load voltage low (red)
 - (xii) Battery room ventilation failed (red)
 - (xiii) Mains on (green)
 - (xiv) Float charging on (blue)
 - (xv) Boost charging on (amber)
 - (xvi) Lamp test push button

Technical Data to Be Submitted

The following information shall be submitted for assessment upon request by the Employer/Engineer:-

- (a) Type test certificate of offered or higher type battery charger as per IEC 60146 standard from any of Internationally Recognized Independent Testing Laboratories. In case the Type Test for higher size battery charger, bidder should have offered the provided type tested battery charger.
- (b) Factory Routine Test data of the battery charger.
- (c) General arrangement drawing of charger panel.

Approval Of Drawing & Specification

General arrangement Drawing, Technical Particulars & guarantees etc, shall be submitted to the purchaser by the bidder for approval, prior to the manufacturing of the goods. The bidder shall have to submit four (4) sets of the same for approval within 15 days from the date of issue of purchase order.

Operating Manual and Documentation

Each Battery Charger shall be provided with a set of operating manuals in English language containing:

- a) Detailed description of operation and function
- b) Wiring diagram
- c) Detailed description of card and their connection
- d) Detailed description of PCB board

Nameplate

The following information shall be given on the name plate of each battery charger panel:

- a) Manufacturer's name
- b) Contract Number
- c) Model, year of manufacture and identifying number
- d) Allowable ambient temperature range, safety warning, power supply and technical specifications
- e) Reference Standards
- f) Manufacturer logo or trademark and brand name, Supplier name
- g) Weight and size of equipment (WxHxD in mm)

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For Battery and Battery Charger

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

Sl. No.	Description	Unit	Requirement	Tenderer's Guaranteed Data
A.	BATTERY			
1	Manufacturer		To be mentioned	
2	Model no		To be mentioned	
3	Electrolyte		Nickel Cadmium Alkaline	
4	Installation		Indoor	
5	Operating voltage	V DC	110	
6	Continuous Discharge Current at rate of 10 hour & Final Cell Voltage 1.1 Volt.	Amp	25	
7	Charging Voltage (Maximum)	Volt	1.54-1.70 Per Cell	
8	Normal float charge rate	A	To be mentioned	
9	Maximum boost charge rate	A	To be mentioned	
10	Voltage per cell	V/ cell	1.2	
11	Capacity at 10 hour rate	Ah	250	
12	Number of cells	Nos	92	
13	Float voltage per cell	V/ cell	1.4-1.42	
14	1. Discharge voltage	V/ cell	1.1-1.7	
	Battery voltage at end of the duty cycle	V	1.1V per cell	
15	Maximum charging rate	A	50	
16	Ampere-hour efficiency at ten hour rate	%	To be mentioned	
17	Ampere-hour efficiency at one hour rate	%	To be mentioned	
18	Dimensions of cells	mm	To be mentioned	
19	Weight of cell complete with electrolyte	kg	To be mentioned	
20	Internal resistance per cell when fully charged	ohms	To be mentioned	
22	Material of battery case		To be mentioned	
23	Standard		IEC 623	
B.	CHARGER			
1	Manufacturer		To be mentioned	
2	Model No		To be mentioned	
3	Rectifier Type		Thyristor	
4	AC input voltage	V	415±15%	
5	Input AC frequency	HZ	50±5%	
6	DC Output voltage			
7	a) Normal Charge	VDC	110±10%	
	b) Float Charge	VDC	1.42 for 110±10%	
	c) Boost Charge	VDC	1.70 volt per cell	
	Output current (continuous)	A	Minimum 70	

Sl. No.	Description	Unit	Requirement	Tenderer's Guaranteed Data
8	Charger Control		As per specification	
9	Charger Protection			
	a)Protective Equipment		As per specification	
	b) Alarms		As per specification	
	c) Monitoring and Control		As per specification	
10	Rated Batter Current	A	To be mentioned	
11	Efficiency	%	To be mentioned	
12	Ripple voltage	%	To be mentioned	
13	Type of AVR		Static	
14	Standard		IEC-146	
C.	CHARGER CUBCLE COMPLETE			
1	Manufacturer		To be mentioned	
2	Overall dimensions		To be mentioned	
3	Total weight		To be mentioned	

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For Air Conditioning System

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

DESCRIPTION		BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
BRAND		Internationally Reputed (To be mentioned by the supplier)	
COMPANY		Internationally Reputed (To be mentioned by the supplier)	
MODEL		To be mentioned by the Supplier	
COUNTRY OF ORIGIN		Japan/Malaysia/South Korea/Taiwan/Thailand/USA/EU Countries	
COUNTRY OF ASSEMBLE		Japan/Malaysia/South Korea/Taiwan/Thailand/USA/EU Countries	
COOLING CAPACITY		28000-30000 BTU/HR	
OUTDOOR UNIT / CONDENSING UNIT	TYPE	Compact weather proof outdoor type condensing unit	
	COMPRESSOR	Hermitically sealed reciprocating/ Rotary compressor	
	REFRIGERANT	Internationally accepted & recommended and most commonly used gas (CFC free)	
	BLOWER MOTOR	Well balanced type direct driven centrifugal type blower fan	
	POWER SUPPLY	200-250 V, single phase, 50 Hz. AC supply	
	Inverter Type	Non-Inverter	
	CONDENSING PIPE/COIL	Made of copper	
	ENERGY EFFICIENCY RATIO (EER)	Minimum 9.23 (BTU/HR)/Watt.	
	COEFFICIENT OF PERFORMANCE (COP)	Minimum 2.70 (W/W)	
	OTHERS FEATURES	(a) Well balanced in all respect having interlock with the fan coil unit. (b) Compressor duly equipped with vibration isolator, thermostatic & overload controls, magnetic contactors and all other standard accessories complete. (c) Refrigerant copper pipe [From outdoor to indoor unit] with thermal insulation, refrigerant charging arrangement etc. [Minimum length 10 meters]. (d) Required size PVC insulated & sheathed, cable with ECC through water grade PVC pipe from outdoor to indoor unit. (e) Sound level: maximum 65 dB(A) at 1 meter.	
INDOOR UNIT / FAN COIL UNIT	FEATURES	(a) Direct expansion system fan coil unit with well-balanced direct driven centrifugal type fan. (b) Fancy & adjustable air circulating louver grill, removable & washable type filter. (c) Condensing water drain out PVC flexible pipe with necessary insulation. (d) Thermostatic switch and remote-control switch. (e) Sound level: maximum 44 dB(A) at 1 meter.	
	STANDARD	Major component — shall be manufactured as per relevant international standard & code.	

DESCRIPTION		BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
	Mount Type	Wall Mounted.	
	WARRANTY	Compressor: 2 Year (Minimum); Service with spares: 2 Year (Minimum)	
	SUPPORTING DOCUMENTS	Must be supported by printed catalogue/manual. Authenticity document (Letter from the parent/authorized company or Verifiable QR/BAR Code and Others) must be supplied with product. If any confusion arises in validation, supplier must clarify any misconception/confusion.	

Specification of Desktop Computer (Brand):

Brand	Internationally Reputed Brand
Model	To be Mentioned by bidder
Country of Origin	To be Mentioned by bidder
Processor	Intel core i5 11 th Generation or Higher
Speed	Turbo Boost System with Minimum 2.9 GHz, 6 Cores
Cache	Minimum 9MB
Chipset	Intel Express Chipset B400 Series or Equivalent or Higher
RAM	Minimum 8GB 2666MHz DDR4L Memory, 2 DIMM slots
HDD	Minimum 1TB 7200 RPM SATA
SSD	Minimum 256GB M.2 NVMe PCIe
LAN Card	Integrated Gigabit LAN-On-Motherboard
Expansion Slots	Minimum (2) PCIe x 1, PCIe x 16
Ports	Minimum (2) USB 3.0, (4) USB 2.0, RJ-45, HDMI, VGA/Display
Wireless	Built-in Wireless 802.11/b/g/n (2.4 GHZ)
Graphics (AGP)	Built-in
Audio (Sound Card)	Built-in
DVD-RW Drive	DVD+/-RW Drive
Monitor	Minimum 18.5" LED Backlit Color, Same Brand
Key-Board	USB enhanced, Same Brand
Mouse	USB Optical Mouse, Same Brand
Power Supply	Minimum 240 W PSU (APFC Full Charge)
OS Support	Windows 10 or Higher.
Software	Windows 10, Office & Other Software as per site requirements.
Power Strip	Brand: Reputed Brand Port: Minimum 5 Port Cable Length: 3 meter Number of pin: Minimum 3 Others: Rated voltage: 220 V, Rated current: Minimum 10 A, Individual switch, Single fuse.
Antivirus	Brand: To be Mentioned By the Bidder Internet Security Antivirus, license for 1 year
Warranty	3 Years (Full).

Laptop (Note Book) Computer

Brand	Internationally Reputed Brand
Model	To be Mentioned by bidder
Country of Origin	To be Mentioned by bidder
Processor	Intel Core i5 (11 th Generation) or Higher
Speed	Turbo Boost System with Minimum 1.3 GHz
Cache	Minimum 12 MB L3 Cache.
RAM	Min. 8GB DDR4, 2666 MHz
Display	Min. 14"HD LED
Graphics	Intel HD Graphics
SSD	Minimum M.2 NVMe™ 512 GB SSD
Sound System	To be mentioned by the bidder
Keyboard	Full-size 85 Keys US Keyboard.
Mouse	Integrated pointing device with touch pad.
Wireless	Integrated
NIC	In-built with 10/100/1000
Web cam	Integrated
Slots	1 Multi-Format Digital Media Card Reader for Secure Digital cards, Multimedia Cards, Multimedia Cards
Expansion Ports/Interface	Min. 3 USB 3.1, 1 HDMI, 1 Microphone/Headphone combo, 1 RJ-45
Battery	Min. 6 Hours Back-up time, 3 Cell 41Whr.
Power Supply	Universal 100 – 240V AC Adaptor for worldwide usage.
Operating System	Free Dos
Carrying Case	Including Original Carrying case
Standard	ISO, CE & FCC Class-B.
Warranty	3 Years.

LV AC Distribution Panel

Vermin and dust proof, completely metal enclosed by sheet steel (11 SWG) with necessary reinforcement, color, Grey with appropriate spray-painting, free-standing type, compact in size, suitable for opening at the back by hinged door with locking device.

There shall be a 3 phase 400 A, 1 kV bus (Cu) arrangement with neutral. Bus being connected with the following MCCB's and instrument:

Voltmeter with 6-position selector switch connected to the bus.

2 × 400A, 4 pole MCCB being interlocked with each other, operative one at a time to bring the input Power to the Bus. Both these incoming feeders shall have 3 x ammeter (each).

2 × 100A, 3 pole MCCB as outgoing.

10 × 60A, 3 pole MCCB as outgoing.

10 × 30A, 3 pole MCCB as outgoing.

The following MCCB & MCB size is the minimum expected and is provided as a guide only. The Contractor shall provide the detailed calculations of the loads and the expected loadings and the sizing of the MCCB/MCB for approval before implementation.

All MCCB's are provided with over load setting and short circuit tripping device. The ACDB panel must be furnished with a good amount of spare MCCB/MCB for further use or design purpose. There shall be a 3-φ 4-wire class 0.2 energy meter for recording the station use. Necessary amount of Voltmeter and Ammeter needs to be provided with digital display type. Instrument transformers related to metering purpose should have accuracy class of 0.2. Necessary terminal blocks and glands/openings shall be provided for the entry of suitable cables.

All equipment/instruments inside the panel shall be arranged neatly and sufficient space shall be provided for easy approach to each equipment/instrument.

Thermostat controlled panel heater, bulb for inside illumination of panel shall be provided. All other features as stated in the table of guaranteed data schedule shall applicable also.

DC Distribution Panel

The switchboard shall comply with the requirements of BS 5468 (IEC 60439)

The distribution switchboard shall be of the cubicle type or otherwise incorporated in the cubicles for battery chargers. Double pole switches and fuses or switch fuses (miniature circuit breakers to BS 4752 or IEC 60127 may only be used if it can be shown that there will be no discrimination problems with sub-circuits) shall be fitted to the DC switchboard as required by substation services but, as a minimum requirement, that set out in the Schedule A of Requirements.

Distribution panels shall be mounted adjacent to the charger control panel and shall be of the cubicle type complying with the general requirements of cubicle type control panels. No equipment associated with the chargers shall be installed in the distribution board.

Distribution panels shall incorporate double-pole switches for each of the outgoing DC circuits and double-pole isolators for the incoming DC supplies. The panel shall be provided with a voltmeter and center zero ammeter on each incoming circuit.

A double pole switch or contactor shall be provided for the purpose of sectionalizing the busbar.

A battery earth fault detecting relay, which will center tap the system via a high resistance, shall be incorporated in the distribution panel.

A low voltage detecting device for the system shall be incorporated in the distribution panel. No-volt relays will not be accepted for these devices. The voltage setting shall be adjustable over an approved range.

In addition to any other requirements specified elsewhere, the battery earth fault detecting relays and low voltage devices shall each have three alarm contacts, one for local visual annunciation, one for the station control panel alarm indication and one for potential free contact for external supervisory alarms. A lamp test facility shall be provided.

Connections between the battery and the distribution cubicle shall be made in PVC insulated cable as required. Cable laid in runs where it may be subject to damage shall be protected by wire armoring, be sheathed overall and be cleated to walls as required.

Cable boxes or glands shall be provided as appropriate for all incoming and outgoing circuits of the distribution switchboard and associated battery chargers. Each circuit shall be suitably labelled at the front of the panel and at the cable termination where the terminals shall be additionally identified.

Charging and distribution switchboards shall be provided with an earthing bar of hard drawn high conductivity copper which shall be sized to carry the prospective earth fault current without damage or danger.

Necessary amount of Voltmeter and Ammeter needs to be provided with digital display type. The DCDB panel must be furnished with a good amount of spare MCCB/MCB for further use or design purpose.

The cubicles for the chargers and distribution boards shall be of rigid, formed sheet metal construction, insect and vermin proof, having front facing doors allowing maximum access to the working parts, when open. The design of the cubicles for the chargers shall be such as to prevent the ingress of dust and minimize the spread of flames or ionized zones, shall be to IEC 60529 IP52, but at the same time shall provide all necessary ventilation and cooling. The design of the frames shall allow the clamping and holding of all chokes, transformers and similar sources of vibration, so that vibration will be minimized, satisfy relevant standards, and not limit the life of the equipment. The frame shall allow the fixing of lifting and so that the equipment remains properly mechanically supported whilst being transported, lifted and installed.

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
LV AC / DC Distribution Panel

S/L	Description	Unit	Employer Requirement	Tenderers Guaranteed Values
DC DISTRIBUTION PANEL				
1	Manufacturer's name & country		To be mentioned	
2	Rated normal current of Bus-bar	A	200	
3	No. and size of fuse circuits	nos./ A	To be mentioned	
4	Thickness of sheet steel (enclosure)	mm	To be mentioned	
5	Dimension	mm x mm x mm	To be mentioned	
6	Weight	Kg	To be mentioned	
7	MCCB & MCB			
	a) Manufacturer's Name		To be mentioned	
	b) Place of Manufacturer		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland	
	c) Manufacturer's model no.		To be mentioned	
	d) Rated voltage		To be mentioned	
	e) Rated current		To be mentioned	
8	Ammeter and Voltmeter Type		Digital	
AC DISTRIBUTION PANEL				
1	Manufacturer's name & country		To be mentioned	
2	Rated normal current of Bus-bar	A	400	
3	No. and size of fused circuits	nos/ A	3	
4	Thickness of sheet steel (enclosure)	mm	4	
5	Dimension	mm x mm x mm	To be mentioned	
6	Weight	Kg	To be mentioned	
	MCCB & MCB			
	a) Manufacturer's Name		To be mentioned	
	b) Place of Manufacturer		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland	
	c) Manufacturer's model no.		To be mentioned	
	d) Rated voltage		To be mentioned	
	e) Rated current		To be mentioned	
8	Energy Meter		To be provided	
9	Ammeter and Voltmeter Type		Digital	

SUBSTATION EARTHING SYSTEM

1. GENERAL

Circuit breakers, power transformers, voltage transformers, auxiliary transformers, earthing switches and other electrical apparatus shall each be connected to the main earth bus by means of a separate subsidiary connection. Gradient control mats shall be installed adjacent to each circuit breaker and disconnect switch mechanism box. Each mat shall be connected directly to the earth grid and the equipment.

Isolating supports, bus bar supports and cable sheaths may be earthed in groups by a separate branch connection from each item of equipment in the group the branch connections being connected by a single subsidiary connection to the main earth. Isolating and earth switch mechanism boxes shall be earthed by a connection separate from that effecting the earthing of the associated switch.

The main members of the steel structures shall be earthed by continuous copper connections bonded to the steelwork and these connections shall be connected separately at each column to the main or subsidiary earth. There shall be 2 connections to each structure and 1 to each piece of high voltage apparatus.

Connections to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected against electrolytic corrosion.

Current transformer and voltage transformer secondary circuits shall be complete and shall be earthed at one point only (at the control building) through links situated in an accessible position. Each separate circuit shall be earthed through a separate link, suitably labelled. The links shall be of the bolted type, having necessary provision for attaching test leads.

The earth system shall be designed so as to include all overhead line terminal Poles, by bonding the overhead earth wire to the earth grid by means of a link which shall be capable of being removed for testing purposes.

The terminal pole shall also be included within the boundary of the earth grid by extending the grid if necessary.

Structures and masts for lighting and security surveillance equipment shall also be within the perimeter of the earth grid. No fixed low voltage equipment, with the exception of a warning or alarm button and intruder alarms, which shall be of the double insulation type, shall be erected outside the perimeter of the earth grid.

All control and relay panels shall have a continuous earth bus run of sectional area approved by the Project Manager along the bottom of the panels, each end being connected to the main earthing system. Metal cases of instruments and metal bases of relays on the panels shall be connected to this bar by conductors of sectional area approved by the Project Manager.

Loops shall be provided on the earthing system in positions approved by the Project Manager, for the attachment of portable earth connectors during maintenance. These will normally be in the earth bar run between the equipment and the base of the structure. They shall be formed separately from the bar and soldered or thermo-welded thereto. Where necessary, rods shall be provided at the tops of bushings or insulators for the attachment of portable earth clips.

Earthing for any high frequency coupling equipment, if applicable, and surge diverters shall be via a

copper rod driven directly into the ground at a position immediately adjacent to the equipment being earthed in addition to the normal earth connection.

2. EARTHING SYSTEM DESIGN

The earthing system shall be designed to meet the requirements of this specification and shall be in accordance with "The Guide for Safety in Alternating Current Substation Grounding" as published by the Institute of Electrical and Electronic Engineers Incorporated, Publication IEEE 80 and 142. The Contractor shall present calculations to show the earthing system meets these requirements and can be shown to be safe in terms of touch, step and transferred potentials. The earth resistance should be kept below or equal to 0.2Ω .

Electrical measurements of the subsoil at various depths, up to 20 metres shall be made at the site of the substation in order to determine the layered effects of the ground from which the effective ground resistivity and hence the expected resistance of the proposed earth grid system may be predicted.

Soil composition may be highly corrosive and special consideration shall be given to this problem. The earth grid shall be effectively protected against corrosion. Cathodic protection, if considered, may adversely affect other equipment and shall be subject to approval by the Project Manager.

In actual design, the earthing system shall take the form of a combination of grids of buried conductors and earth rods driven vertically into the ground. Within the grid, conductors shall be laid in parallel lines at reasonably uniform spacing. They shall be located along rows of structures or equipment to facilitate the making of earth connections, where practical.

The main earth and each subsidiary earth shall have a sectional area, as required for 31.5 kA for 1 sec, in any case not less than 120 mm^2 in any part of its length. Each branch connection shall have a sectional area of not less than 120 mm^2 .

Connections to the grid of all non-current carrying metallic parts, which might become energized by chance, such as metal structures, building earth, equipment, earth rods, water pipes, etc. shall not be less than 120 mm^2 and shall be of adequate size, current-carrying capacity and mechanical ruggedness.

The spacing between conductors forming the mesh system shall be such as to limit the grid potential rise to a value that limits the touch voltage to a value not greater than the maximum tolerable touch potential assuming a fault clearance time equal to that of the main protection equipment being provided.

Each group of earth conductor shall be connected to the main earth grid through connections having a sectional area of not less than 120 mm^2 which shall be protected from corrosion.

The grid shall be subdivided into a number of sections, interconnected with test links. These links shall be accessible from above-ground.

Areas of the grid, where high concentrations of fault currents can appear, as at neutral earthing connections, shall have reinforced conductor sizes where necessary, to handle adequately the highest fault current and its duration.

In case the equipment is widely spaced in the station, individual local grids may be established at the various equipment locations and the local grids shall be interconnected and connected to the overall earth grid. Interconnecting conductors shall not be less than the size of the conductor for main grid.

Metal parts of all equipment, other than those forming part of an electrical circuit shall be connected directly to the main earth system via a single conductor. The arrangement of the mesh earth

system shall be such as to minimize the length of these single connections.

Earth bars installed directly into the ground should normally be laid bare and the trench back-filled with fine topsoil. Where the soil is of a corrosive nature, precautions must be taken to protect the earth bar.

All trenches shall be backfilled in compacted 100 mm layers. All stones and other sharp objects shall be removed from the backfill by a suitable sieve.

Copper to copper joints on strip conductor shall be brazed, using zinc-free brazing material with a melting point of not less than 600°C, or by approved exothermic welding. All exposed joints shall be at a minimum height of 150 mm above floor or ground level. Earth conductor joints that are required to be broken for testing or maintenance shall have mating surfaces tinned.

After installation of the earth system the Contractor shall measure the resistance of the substation. The method used shall preferably be the "fall of potential" method, requiring the availability of a local low voltage supply but other methods using an earth resistance megger will be acceptable in the event of a local supply being unavailable.

In the case of surge (lightning) arrestors a local earth connection shall be made by driving electrodes into the earth near the arrestors and the lightning arrester earth conductor shall be connected to both the rod and to the common earthing grid of the station. The connection from arrester to earth shall be as short and as straight as possible. The conductor shall not be less than 120 mm².

The measured earth resistance shall not exceed 0.5 ohm. A value higher than 0.5 ohm shall be subject to the approval of the Project Manager. The resistance shall be measured with all transmission line earth wires connected to the earthing grid.

In the event of the substation resistance obtained with the foregoing installation being of a magnitude unacceptable to the Project Manager, then where practicable, the ground area enclosed by the earth system shall be increased by installing directly in the ground an additional copper conductor in the form of a ring around the site, or by additional conductors within the site. Alternatively earth conductors can be directly buried radially outside the substation perimeter fence. The use of earth plates as current carrying electrodes is not acceptable. Any additional conductors shall be as directed by the Project Manager.

From the point of view of the possible damage to apparatus, the earthing system shall be such as to limit voltage appearing between the substation equipment and the main body of earth, so that insulation breakdown or burning does not occur on apparatus. For the same reason, voltage rise between earthed points in the substation shall be kept to a minimum. In addition, the effectiveness of any surge protection devices shall be fully realized by providing an adequate earth path. In this case, the earthing system shall not only be of low resistance, but of as low reactance as practicable.

N.B: For the earthing system design copper conductor shall be considered instead of copper earth electrode.

3. STEP AND TOUCH VOLTAGE

The earthing systems shall be so designed as to keep the "step" and "touch" potentials within acceptable limits, thereby ensuring safety to the personnel. The aim shall be to ensure that under either normal or abnormal conditions no dangerous voltages can appear on the equipment or accessories to which a person has legitimate access.

The step and touch potential voltages obtained inside the site and at selected locations around the fence/gate shall also be measured by a suitable method acceptable to the Project Manager. Appropriate measures shall be taken to rectify the causes of any deviations from allowable values.

4. FENCE AND PERIMETER EARTHING

The fence surrounding the substation shall be earthed to its own earth grid and the fence earth grid shall be connected to the main station earth grid at frequent intervals as approved by the Project Manager.

A continuous conductor shall be laid outside the periphery of the substation site at a distance of 1.0 metre from the boundary fence and at a depth of 0.6 metres below the surface. This shall be welded to earth rods installed at adequate intervals and at points adjacent to each corner and immediately below any overhead line entering or leaving the site. The location of the mesh conductors shall be such as to enable all items of equipment to be connected to the earth system via the shortest possible route. All corner fence posts and posts adjacent to earth rods shall be effectively connected to the earth conductor.

Gateposts forming part of the substation fence shall be bonded together with below ground connections and the gates themselves shall be electrically bonded to the posts.

The alternative approach of independently earthing the fence and placing it outside the earth grid area shall only be adopted if the above mentioned procedures prove insufficient or impracticable. The Contractor shall provide calculations to show that this approach produces safe touch voltages at the fence and shall ensure that the fence is isolated from all other buried metalwork.

5. TESTS

All relevant type and routine tests shall be carried out.

Complete charge and discharge tests on each of the combined batteries and chargers shall be conducted and results recorded so as to permit verification of the ampere-hour capacity of the battery. During these tests the Project Manager shall select at random reference cells and the voltage curves thereof shall be checked when the battery is discharged over three and ten hour periods. The alarm levels and the automatic voltage control feature of the charger shall be demonstrated over the specified load range.

A. ELECTRICAL

3.0 TESTING AND COMMISSIONING

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3.0 Testing and Commissioning

The Contractor shall include comprehensive Inspection and Test Plans in its Quality Plan. Factory testing shall include all type tests and routine tests set out in the relevant IEC standards and in the Particular Technical Requirements.

If satisfactory type tests have been carried out on identical equipment the Contractor shall submit copies of the test certificates to the Employer. The Employer may waive the requirement for any of the type tests if it approves these test certificates.

The Employer will witness all factory inspections and testing. The Contractor shall notify the Employer of its intention to conduct factory inspection and testing for each lot of equipment at least one month in advance, and shall not perform such testing unless the Employer witnesses the test or a waiver has been provided by the Employer.

The notification shall include full details of the equipment, manufacturers and proposed tests, including:

- Contract identification
- Full details of equipment to be tested
- Manufacturer's name, address and contact information Contractor or manufacturer's staff responsible for the testing
- Location and date of tests
- Schedule of tests to be performed and standard to be applied List of relevant drawings and documents

In the following sections, various relevant standards and tests are listed. These are not intended to be exhaustive. If other standards and/or tests are relevant, they shall also apply.

3.1 Motors

One motor of each type and rating shall be type tested and all motors shall be routine tested in accordance with the tests specified in IEC 60034, NEMA MG 1, IEEE 112, 114, 115 and 85.

3.2 Relays

3.2.1 Type Tests

Type test results shall be submitted for approval for each type and rating of relay.

Type tests may be waived at the Project Manager's discretion if adequate type tests have already been performed and copies of the type test reports are supplied.

3.2.2 Routine Tests

All relays and associated equipment shall be routine tested as required by the standards to prove the quality and accuracy. Routine tests shall be in accordance with relevant IEC recommendations and BS 142.

All relays shall be subjected to the appropriate routine tests as listed below, the individual tests being as detailed in IEC 60255 or as otherwise agreed with the Project Manager.

- ☐ Accuracy of calibrated pick-up and drop-off levels over the effective range of settings ☐ Insulation tests
- ☐ Accuracy of timing elements
- ☐ Correct operation of flag (or other) indicators
- ☐ Mechanical requirements, integrity/safety of draw-out units, check of contact pressure and alignment.

3.3 Instrument Transformers

All required tests shall be carried out as per relevant IEC standards.

3.4 Electrical Instruments and Meters

One instrument and meter of each type and rating shall be subjected to the test as specified in IEC 60051.

3.5 AC Switchboards/ Contacts/L.V Equipment

Routine tests shall include general inspection and electrical operation tests.

3.6 PVC Cable

Each size and rating of PVC cable shall be subjected to type tests as specified in BS 6346. Routine tests are detailed in this document.

3.7 Metal Clad Switchgear

One circuit breaker, disconnecter, earthing device and other switchgear equipment of each rating and type shall be subjected to the type tests laid down in IEC 60056, ANSI C37, IEC 62271-100 and other relevant IEC standards. In cases where documentary evidence is produced that a circuit breaker of exactly similar design has been type tested by an approved and independent testing station, the type test requirement may be waived.

The circuit breakers of each type shall be either fully assembled at the manufacturer's works and subjected to operation tests and power frequency tests or, where not assembled at works, separate power frequency voltage tests shall be performed on all major insulation components.

Routine tests in accordance with IEC 60056, IEC 62271-100 or ANSI C37 shall be carried out on all circuit breakers. These shall include operation tests, millivolt drop tests and power frequency voltage tests. Routine tests in accordance with the relevant IEC standards, including operation tests and power frequency voltage tests, shall be carried out on all switchgear.

3.8 Disconnectors and Earth Switches

Tests shall be carried out as required according to the following standards:

- ☐ Type and routine tests to IEC 60129 (BS 5253).
- ☐ Type and routine tests to IEC 60265 for switch disconnection. ☐ Routine high voltage and mechanical test of insulators.
- ☐ Sample and type tests of insulators

3.9 Bushings and Insulators

Routine, sample and type tests shall be carried out in accordance with the specified standards. Type tests shall also be carried out unless approved type test evidence is submitted. These tests shall include temperature cycle and porosity tests.

The following standards shall apply:-

- ☐ IEC 60233 (BS 4963) for hollow porcelains. ☐ IEC 60137 for bushings.
- ☐ IEC 60148 and 60273 (BS 3297) for high voltage post insulators.
- ☐ IEC 60383 and 60305 (BS 137 Part 1 and Part 2) for cap and pin string insulators.

3.10 Current and Voltage Transformers

Type and routine tests shall be carried out according to IEC 60185 (BS 3938), IEC 60186 (BS 3941), IEC 60044-1 and IEC 60044-2.

3.11 Structures of Electrical Equipment

Sample tests on the assembly and galvanizing of the structures shall be carried out. A mechanical type test with the structure loaded with working load multiplied by the appropriate factor of safety shall be carried out.

3.12 Surge Arresters

Routine tests and type tests shall be carried out to the specified standards.

The following routine tests shall be carried out on all arrester units in accordance with clause 8.1 of IEC 60099-4.

- ☐ Measurement of reference voltage
- ☐ Residual voltage test
- ☐ Partial discharge test
- ☐ Housing leakage test
- ☐ Current distribution test for multi-column arrester

3.13 Batteries and Battery Chargers

All relevant type and routine tests shall be carried out.

Complete charge and discharge tests on each of the combined batteries and chargers shall be conducted and results recorded so as to permit verification of the ampere-hour capacity of the battery. During these tests the Project Manager shall select at random reference cells and the voltage curves thereof shall be checked when the battery is discharged over three and ten hour periods. The alarm levels and the automatic voltage control feature of the charger shall be demonstrated over the specified load range.

3.14 Control Panels

Routine operation tests and insulation resistance tests shall be carried out.

3.15 Metal Clad Switchgear Busbars

Routine tests including millivolt drop tests shall be carried out in accordance with the specified standard. Type tests shall also be carried out on each busbar design unless approved type test evidence is submitted.

3.16 Instruments

Calibration tests shall be carried out on all important pressure gauges and other instruments as required by the relevant standards. Site tests shall also be carried out to prove compliance.

3.17 Power Transformers

Testing shall include all routine electrical, mechanical and hydraulic tests in accordance with the relevant IEC or British Standard, except where departures there from and modifications thereto are embodied in this specification. For plant not covered by any IEC or British Standard or specifically mentioned in this specification, such tests as are relevant shall be agreed with the Project Manager.

Should the plant, or any portion thereof, fail under test to give the required performance, further tests which are considered necessary by the Project Manager shall be carried out by the Contractor and the whole costs of the repeated tests borne by the Contractor. This also applies to tests carried out at the Sub-contractors' works.

After satisfactory completion of the witnessed tests at the works, the Plant shall be submitted for the Project Manager's approval during dismantling preparatory to shipment. No item of Plant is to be despatched to site until the Project Manager has given his approval in writing.

Routine Tests

All transformers shall be subject to the routine tests and routine test sequence (mentioned in Section VI Part 2 Electrical Transformer Specification (Clause 5)) in accordance with IEC 60076 and the requirements of this Specification.

The test shall be in accordance with IEC 60076, Part 2, and shall be carried out on one transformer of each size and type. Temperature-rise tests shall be conducted on the tapping corresponding to the maximum losses.

All relevant type tests shall be carried out or documentary evidence of tests on similar designs presented.

Temperature Rise Test:

This shall be carried out in accordance with IEC 60076 Part 2.

Noise Level Tests:

A noise level test according to IEC 60075 shall be carried out on one transformer of each type specified under items 1 and 2 in accordance with IEC 60551.

Special Tests

As mentioned in Section VI Part 2 Electrical Transformer Specification (Clause 5).

3.17.1 Voltage Control Equipment

The following tests shall be carried out:

Routine Tests

Each finished tap changer shall be subjected to the routine tests specified in IEC 60214.

Type Tests

Type tests shall be carried out entirely in accordance with IEC 60214 except that evidence of the service duty type test shall be in excess of 100,000 operations.

3.17.2 Magnetic Circuit

The following tests shall be carried out:

Routine Tests

Each core completely assembled shall be tested for one minute at 2,000V AC between core bolts, side plates, structural steelwork and core at the core and coil stage. After the transformer is tanked and completely assembled, a further test shall be applied between the core and the earthed structural steelwork to prove that the core is earthed through the removable link, at one point only.

3.17.3 Outdoor Bushing Assemblies with Porcelain Insulators

The following tests shall be carried out:

Hollow insulators tested in accordance with IEC 60233.

Complete bushings tested in accordance with IEC 60137.

All relevant type and routine tests shall be carried out.

3.17.4 Tanks

The following tests shall be carried out:

Routine Tests shall include:

Oil Leakage:

All tanks, conservators and oil filled compartments, which are subjected in service or during maintenance to oil pressure, shall withstand without leakage a hydraulic pressure test equal to 69 kN/m^2 or the normal pressure plus 34 N/m^2 whichever is the greater, for 24 hours during which time no leakage or oil ingress into normally oil free spaces shall occur.

Type Tests:

Unless type test certificates can be produced for tests carried out on similar equipment, the following tests shall be included for tanks and conservators.

i) Vacuum Test:

The equipment shall withstand a full vacuum when empty of oil. The permanent deflection of plates or stiffeners on removal of vacuum shall not exceed the following values:

Length of Plate	Permanent deflection
Less than 1300 mm	3.17 mm
1300 to 2500 mm	9.5 mm
Greater than 2500 mm	12.7 mm

3.17.5 Cooling Plant

The following tests shall be carried out:

Routine Tests

- ☐ Cooler: Pressure test to be as specified above.
- ☐ Motors and control Gear: as required by the standard

3.17.6 Gas and Oil – Actuated Relays

The following tests shall be carried out:

Routine Tests:

- ☐ Oil Leakage, when subject to an internal oil pressure of 207kN/m² for fifteen minutes. ☐ Gas Collection
- ☐ Oil Surge
- ☐ Performance test under service conditions
- ☐ Voltage: 2kV for one minute between electrical circuits and casing.

3.17.7 Galvanizing

Routine Tests shall be carried out to the requirements of BS 443 or BS 729 whichever is applicable

3.18 Station Service Transformer

The following tests shall be carried out:

Routine Tests

- ☐ Measurement of Winding Resistance ☐
- Ratio, polarity and phase relationships ☐
- Measurement of impedance voltage

- ☐ Measurement of loss
- ☐ Short duration power frequency voltage-withstand test ☐
- Induced over voltage withstand test
- ☐ Insulation resistance of each winding

Type Tests

All relevant type tests including a temperature rise test shall be carried out.

Unless acceptable type test certificates can be submitted in respect of a transformer similar in design to that specified, a temperature rise test shall be carried out and the costs shall be included in the contract Price. This test shall take into account temperature rise due to both the specified earth fault current and continuous operation at CMR of the auxiliary winding.

3.19 Prior to Shipment

After the satisfactory completion of all tests at the factory, the plant shall be submitted for the Project Manager's approval during dismantling preparatory to shipping. No item of plant shall be despatched to site until the Project Manager has given approval in writing.

3.20 Inspection and Testing During Site Erection and Commissioning

3.20.1 General

The Contractor shall be responsible for the inspection and testing during site erection, to ensure correct erection and compliance with the specification. Tests carried out during testing and commissioning shall include those tests listed in this section but shall not be limited to them.

During the course of erection, the Contractor shall provide access as required by the Project Manager for inspecting the progress of the works and checking its accuracy to any extent that may be required.

The Contractor shall provide, at its own cost, all labor, materials, stores, and apparatus as may be required and as may be reasonably demanded to carry out all tests during erection, whether or not the tests are specifically referred to in this specification. All power supplies (including 50Hz AC) shall be provided by the Contractor.

A full site test program shall be submitted for approval. This shall include a brief description of all tests and testing procedures and shall be provided before tests commence and the method of testing, unless otherwise specified, shall be agreed with the Project Manager.

The Contractor shall provide experienced test personnel and testing shall be carried out during normal working hours as far as is practicable. Tests which involve existing apparatus and outages may be carried out outside normal working hours. The Contractor shall give sufficient notice to allow for the necessary outage arrangements to be made in conformity with the testing program.

The Contractor shall record the results of the tests clearly, on an approved form and with clear reference to the equipment and items to which they refer, so that the record can be used as the basis for maintenance test during the working life of the equipment. The required number of site test result records shall be provided by the Contractor to the Project Manager as soon as possible after completion of the tests.

No tests as agreed under the program of tests shall be waived except upon the instruction or agreement of the Project Manager in writing.

The Contractor's test equipment shall be of satisfactory quality and condition and, where necessary, shall be appropriately calibrated by an approved authority at the Contractor's expense. Details of the test equipment and instruments used shall be noted in the test sheets in cases where the instrument or equipment characteristics can have a bearing on the test results.

The testing requirements detailed under this specification may be subject to some variation upon the instruction or agreement of the Project Manager where necessitated by change conditions at site of by differing design, manufacture, or construction techniques.

The Contractor shall be responsible for the safe and efficient setting to work of the whole of the plant and equipment. The methods adopted shall be in accordance with any safety and permit regulations in force by the Employer on the site.

3.20.2 Mechanical Equipment

The extent of testing during erection shall include, but not be limited to, the following.

- ☐ Checking the accuracy and alignment of plant erected. The accuracy shall comply with the relevant standards, the specification or the plant manufacturer's requirements as may be applicable or where no requirements exist, to a standard to be agreed between the Project Manager and the Contractor.
- ☐ Checking the alignment of rotating equipment to the manufacturer's requirements.
- ☐ ☐ Non-destructive testing of site welds as required by the relevant standard and as detailed in this specification.

3.21 Commissioning Tests

At least two months before commencing the commissioning of any plant or equipment, the Contractor shall submit for approval fully comprehensive schedules of pre-commissioning checks as applicable to each item of the plant and equipment provided. These schedules shall then be used during pre-commissioning as a guide to the methods to be followed and to record the actual activities carried out with the appropriate date, together with details of all work yet to be completed, variations and modifications to design conditions.

In addition the Contractor is to submit with the schedules to the Project Manager proforma test sheets (to be used by the Contractor during testing and commissioning) for all tests he proposes to carry out and those required by the Project Manager.

Each activity on the schedules, when completed to the satisfaction of the Project Manager, shall be signed and dated by the Contractor. The schedules shall be countersigned by the Project Manager as necessary. If during the performance of the pre-commissioning checks the Project Manager considers that additional tests are necessary to prove the system or plant the Contractor shall perform such additional tests to the Project Manager's satisfaction.

Each activity on the commissioning procedure schedules when completed to the satisfaction of the Project Manager, shall be signed and dated by the Contractor and shall be countersigned by the Project Manager as necessary.

The commissioning procedures shall ensure that the commissioning of any section of the Works does not interrupt the normal commercial operation of any previously commissioned section(s).

At least 14 days prior to commencing commissioning checks, the Contractor is to agree with the Project Manager, the method and sequence of performing the commissioning tests. Following agreement the Contractor shall submit a detailed program indicating the testing sequence to permit advance notice to be given to the Employer in order that the Employer's representatives may also witness testing.

For the purposes of this Contract, the provisions of this section will apply to plant supplied from nominated sub-contractors.

3.21.1 Contractor's Site Supervisory Staff

During the commissioning and subsequent testing of any item of plant the Contractor shall provide the services of any special supervisory staff necessary for the purpose of ensuring proper commissioning and the satisfactory completion of all tests. The cost of any such specialized services is deemed to be part of the bid price for erection of plant.

3.21.2 Commissioning of Modified Circuits

Where the scope of works has included the diversion, relocation or variation of any existing circuit the Contractor is deemed to have included for all pre-commissioning checks on existing equipment. Where this work includes overhead line or cable circuits the Contractor is responsible for carrying out full pre-commissioning and on-load checks at the remote end of the circuit including the injection testing and re-setting of relays if required.

All and any such work associated with the re-commissioning of existing equipment is deemed to be included in the contract price.

3.21.3 Test Equipment

The Contractor is responsible for providing all equipment, power, etc. necessary to carry out all tests on site. Following award of contract, at the appropriate time, the successful Contractor shall submit a detailed schedule of the test equipment etc., he intends to provide for carrying out this portion of the works. Should the Project Manager require additional or alternative test equipment to be provided to enable full site testing to be performed in accordance with the requirements of the specification, the Contractor shall supply such equipment at no extra cost.

3.21.4 Owner Participation

The Contractor shall plan for Employer staff participation either continuously or on a regularly recurring basis in the commissioning work with the primary intent of:

- a) Staff becoming familiar with the operating and maintenance aspects of the new equipment.
- b) Staff maintaining a continuing assessment of the precautions required in, or possible consequences of, initial energization of equipment.

These two objectives must be allowed for in the preparation of schedules.

3.22 Commissioning of Electrical Equipment

3.22.1 General

A general check of all the main switchgear and ancillary equipment shall be made and shall include a check of the completeness, correctness and condition of earth connections, labeling, arcing ring and horn gaps, clearances, painted surfaces, cables, wiring, pipe work, valves, blanking plates and all other auxiliary and ancillary items. Checks shall be made for oil and gas leaks and that the insulators are clean and free from external damage. A check shall be made that loose items which are to be handed over to the employer e.g. blanking plates, tools, spares, are in order and are correctly stored.

The following general tests are to be carried out on electrical equipment after erection at site:-

Routine high voltage tests to the appropriate IEC standard. Where no relevant standard exists, tests shall be agreed with the Project Manager.

- ☐ Insulation resistance tests on all electrical equipment. ☐ Continuity and conductivity resistance tests.
- ☐ Test operation of alarm and tripping, devices to local and remote. ☐ Rotational tests on all motors.
- ☐ Polarity tests on CTs and VTs. ☐ Oil tests.
- ☐ Grounding system and electrode tests.
- ☐ Ratio, vector grouping and magnetizing current tests on each transformer. ☐ Calibration of winding and oil temperature devices.
- ☐ Vector group and phasing tests on VT circuits.
- ☐ Magnetization current/voltage tests, knee voltage, accuracy and winding resistance tests on all current transformers.
- ☐ Primary and secondary injection tests on relays, protection devices and equipment.

3.22.2 Transformers

The site tests, full details of which are to be submitted by the Contractor after the Contract has been placed, shall include those tests described in outline below.

- (a) Insulation resistance of core and windings. (b) Dielectric strength of oil samples.
- (c) Ratio and no-load current at low voltage (e.g. 400 V) on all tapplings. (d) Vector notation check.
- (e) Calibration check of temperature instruments, including secondary current injection and proving contact settings.
- (f) Air injection tests of gas/oil-actuated relays. (g) Setting check of oil-level and oil-flow devices.
- (h) Complete functional tests of cooling equipment and tap-change equipment, including manual/automatic sequences, indications, alarms and interlocks, measurement of motor currents, adoption of suitable motor protection settings and proof of protection for stalled or single-phasing conditions.
- (i) Operational tests of breathers.
- (j) Insulation resistance of all secondary circuits.
- (k) Carry out "footprint" tests to confirm that no damage to the windings has taken place during transit and installation.

(l) Final checks before energizing:-

Venting, position and locking of valves, earthing of star-point(s) and of tank, state of breathers and of pressure-relief devices, oil levels, absence of oil leakage, operation of kiosk heaters, tap-change counter readings, resetting of maximum temperature indicators, final proving of alarms and trips.

(m) Dissolved Gas Analysis of transformer oil after final processing (n)

Tests when energized:

On-load tap-changer operation throughout range (subject to not exceeding 1.1 pu volts on any windings).

Maintenance of 1.1 pu volts on untapped windings for 15 minutes (but not exceeding this value on tapped winding).

(o) Tests on load:

Temperature instrument readings Measurement
of WTI CT secondary currents

Repeat Dissolved Gas Analysis of transformer oil after energisation tests completed

(p) Oil:

Samples of oil from each consignment shall be tested in accordance with IEC 60296 before dispatch.

Subject to the agreement of the Project Manager a test certificate, confirming that the oil from which the consignment was drawn has been tested in accordance with IEC 60296, may be accepted. Before commissioning any transformer, the electric strength of its oil shall be check-tested and results approved by the Project Manager.

3.22.3 Circuit-Breakers

Circuit-breakers shall be given a visual inspection.

In the case of gas type circuit-breakers testing will be required on the gas system to prove the gas pressure, quantity, dryness and dielectric strength.

Contact resistance tests shall be carried out. In the case of multi-interrupter circuit-breakers resistance tests will be required at each interrupter or pair of interrupters as well as through the series of interrupters on each pole.

Local air components associated with pneumatic operation, including air compressors, shall be tested and air loss measurements and pressure and alarm settings checked. Tests shall be made also on mechanical and hydraulic operation systems.

3.22.4 Disconnectors and Earth Switches

Manual operation of disconnectors and earth switches shall be subject to operational tests to confirm contact pressures, contact resistances, simultaneous operation of all phases and the ease of operation.

Motorized operation of disconnectors and earth switches shall be tested to prove the motor operation, including local and remote operation, and timing tests shall also be carried out. Motor protection shall be tested.

Checks shall be made on interlocks, local and remote indications and operation of auxiliary contacts.

Earth switches shall be tested to confirm the opening and closing sequences and checks shall be made on interlocks, indications and manual locking devices.

3.22.5 Busbars and Connections

Flexible busbars and connections shall be tested to ensure that the correct tensions, sags and clearances will be maintained over the range of environmental conditions and loads without stress to other equipment. If dynamometers are used to check the sags and tensions, they shall be checked both before and after use.

Rigid busbars and connections shall be tested to ensure that the busbars will not cause overloading of the supporting insulators under load conditions and under the range of climatic variations applicable to the site and that expansion and contraction of the equipment is fully accommodated by flexible connections.

Conductivity tests shall be carried out on all connections and joints which are made on site, without exception.

3.22.6 Earthing System

Tests shall be made on the effectiveness of the bonding and earthing which will include conductivity tests on selected joints, on the main earthing system, and at the connections to equipment and structures. Checks shall also be made on precautions taken to avoid corrosion attack on the earthing system.

Test probes at approximately 300 and 600 meters separation will normally be required to effectively test the earthing system. The use of transmission line conductors may be arranged to simplify test testing procedures.

The earth resistance shall be measured during the installation and on completion as follows:-

- ☐ of each earth rod after driving
- ☐ of the earth grid after completion and back-filling of the trenches
- ☐ of each group of earth rods or earth point after completion of the connection from the test link terminal.
- ☐ Of the completed installation without any connections outside the substation

The tests shall be carried out by a method and with equipment approved by the Project Manager. All tests are to be witnessed and the equipment and method used recorded with the test results.

The Contractor may also be called upon to provide assistance in the measurement of earth resistance after earth connections to the system have been completed.

3.22.7 Control Relays and metering Panels, Instruments and Protective Devices

(a) Wiring

After complete erection and cabling, all circuits shall be subjected to the high voltage test specified in the relevant IEC or approved standard.

The insulation resistance of all circuits shall be measured before and after any high voltage tests.

For AC secondary injection tests a substantially sinusoidal test supply shall be used.

The operation and resetting level (current and/or voltage) and timing of all relays shall be measured over an agreed range of settings for all relays.

Other relays shall be fully tested in accordance with the manufacturer's recommendations.

All DC elements of protection relays shall be tested for operation at 70% rated voltage.

All d/c supplies shall be checked for severity of current inrush when energized by switching on or inserting fuses or links.

(b) Mechanical Inspection

All panel equipment is to be examined to ensure that it is in proper working condition and correctly adjusted, correctly labeled and that cases, covers, glass and gaskets are in good order and properly fitting.

(c) General

Sufficient tests shall be performed on the relays and protection schemes to:

- ☐ Establish that the equipment has not suffered damage during transit.
Establish that the correct equipment has been supplied and installed.
- ☐ Confirm that the various items of equipment have been correctly interconnected.
- ☐ Confirm performance of schemes designed on the bases of calculation e.g. differential protection.
- ☐ To provide a set of figures for comparison with future maintenance values allowing the condition of the equipment to be determined.

(d) Secondary Injection

Secondary injection shall be carried out on all AC relays, using voltage and current of sinusoidal wave form and rated power frequency to confirm satisfactory operation and range adjustment.

The polar characteristic of all distance protections shall be recorded at a minimum of 30 degree intervals.

For circulating current protection employing high impedance voltage operated relays, the points of injection for relay voltage setting tests shall be across the relay and stabilizing resistance.

The fault setting for the type of protection is to be established by secondary injection, where it is impracticable to ascertain this value by primary injection. Injection is to be made across the appropriate relay bus wires with all associated relays, setting resistors, and CT's connected.

(e) Primary Injection

All current operated relays shall be tested by injection of primary current to record the actual relay setting and as a final proof of the integrity of all secondary connections.

The stability of all differential schemes shall be checked by injection of primary current.

Primary current injection tests are to be carried out by the Contractor and the methods employed for a particular installation are to be agreed with the Project Manager.

Tests are to be carried out as follows:

- ☐ Local primary injection to establish the ratio and polarity of current transformers as a group, care being taken to prove the identity of current transformers of similar ratio.
- ☐ Overall primary injection to prove correct interconnection between current transformer groups and associated relays.
- ☐ Fault setting tests, where possible, to establish the value of current necessary to produce operation of the relays.

(f) DC Operations

Tests are to be carried out to prove the correctness of all DC polarities, the operating levels of DC relays and the correct functioning of DC relay schemes, selection and control switching, indications and alarms. The correct functioning of all isolation links and fuses shall also be checked.

(g) Tests on Load

Tests on load shall also be done to demonstrate stability and operation of protection relays as required by the Project Manager.

All tripping, control, alarm and interlocking circuits shall be functionally tested to prove satisfactory and full proof operation and/or resetting. The functional and safety aspects of all shorting and/ or isolation links, fuses and switches devices shall be proved.

The total burdens connected to all voltage transformer circuits shall be measured and recorded.

The total capacitance of all wiring and apparatus connected to the negative pole of each main tripping battery shall be measured and recorded; the value shall not exceed 10 microfarad.

The continuous current drain of all trip circuit supervision relays shall be measured and shall not be greater than half the minimum current required for tripping. The supervision current shall be measured with the circuit-breaker (or other device) both open and closed.

Batteries and Chargers

Tests shall be carried out on the batteries and chargers to confirm the charger ratings and adjustment, the battery and charger alarm systems and battery capacity.

The open-circuit cell voltages of the batteries when fully charged shall be recorded.

The insulation to earth of the complete DC installation shall be tested.

Power Cables

Each completed circuit shall be tested for continuity and insulation resistance.

Current Transformers

A magnetization curve shall be obtained for each current transformer in order to:-

- ☐ Detect damage in transit or installation
- ☐ Prove that the correct cores have been wired out to the relevant terminals
- ☐ For high impedance relay schemes, to confirm that correct relay settings have been calculated.
- ☐ The DC resistance of each current transformer secondary winding shall be measured and also the transformers and connection leads, each item being recorded separately.
- ☐ The insulation resistance of all secondary circuits shall be measured at 1000 volt and recorded.

Primary current injection tests shall be conducted on all current transformers using adequate primary current to prove correct ratio, polarity and, for differential protection schemes, to prove the correct relative polarities of all current transformers of each scheme.

Voltage Transformers

The transformer ratio and polarity shall be checked using a primary voltage high enough to give a clearly measurable secondary voltage or by using rated primary voltage and comparison with an already proven voltage transformer. The phasing and phase rotation shall be checked. For three phase voltage transformers a test shall be conducted to show that energizing each primary winding produces an output from only the correct phase secondary winding. The residual voltage of any open delta or broken delta winding shall be measured with rated primary voltage applied.

Control and Instrumentation Equipment

The following general tests shall be performed on control and instrumentation equipment at site:

- ☐ Insulation resistance testing of all circuits.
- ☐ Functional tests for all tripping, control, alarm and interlocking circuits.

The testing of all equipment in accordance with the manufacturer's instructions or as advised by the Project Manager.

Transformers and Ancillary Equipment

The following tests shall be performed.

- ☐ Insulation resistance tests on bushings.
- ☐ Insulation resistance test at 500V between core and core clamping structure. ☐ Voltage withstand tests on insulation oil to BS 148.

- ☐ Ratio test.
- ☐ Phase relationship
- ☐ Magnetization characteristics of current transformers of winding temperature devices. ☐
- Calibration of winding temperature devices.
- ☐ Tap Selector and Diverter Switch alignment.
- ☐ Calibration of automatic voltage control equipment. ☐
- Proving tests as necessary on control schemes.
- ☐ Measurement of winding resistance on all taps and phases.

3.22.8 Inspection Plan and Procedures

3.22.9 Measuring and Testing Equipments

At prescribed intervals, or prior to each use, all measuring and testing equipment used in inspection shall be calibrated and adjusted against certified equipment having a known valid relationship to nationally recognized standards. Where no national standards exist, the basis employed for calibration shall be approved by the Project Manager.

The manufacturer shall prepare a calibration schedule showing equipment type, identification number, location, frequency of checks, method of checking and action to take when results are unsatisfactory.

Each piece of equipment shall be labeled with its identification and current calibration status.

Calibration records for each piece of equipment shall be maintained at least for life of that piece of equipment and shall be available for examination by the Project Manager.

3.22.10 Re-inspection Following Non-Conformance

If a non-conformance report is issued as specified in this clause and the clause below, the Contractor shall reimburse the Project Manager for all costs incurred by its staff (including time costs, travel, accommodation etc.) for both attending discussions on remedial matters and any re-inspection that the incurred by its staff may deem to be necessary.

3.23 Plant Performance

3.23.1 Guarantees

Bidders shall state and guarantee the technical particulars listed in the Schedules of Technical Particulars and Guarantees. These guarantees and particulars shall be binding and shall not be deviated from without the written permission of the Project Manager.

The tolerances permitted in the IEC or other standard shall apply unless otherwise stated.

3.23.2 Rejection

If the guarantees are not met and/or if any items fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or during the maintenance period, the Project Manager may reject the item, or defective component thereof, whichever he considers necessary, and after adjustment or modification as directed by the Project Manager, the Contractor shall submit the item for further inspection and/or test. The repair procedure shall be to the Project Manager's approval. In the event of a defect on any item being of

such a nature that the requirements of this Specification cannot be fulfilled by adjustment or modification, such item shall be replaced by the Contractor, at his own expense to the entire satisfaction of the Project Manager. Any item of plant repaired to an approved procedure shall not be accepted as a part of the Works as a permanent solution or replacement unless the Contractor guarantees in writing that the repaired plant or component shall have the same service life and efficiency as the component originally manufactured.

3.24 Manufacturer's Standard Tests

3.24.1 General

Where no specific test is specified then the various items of plant, materials and equipment shall be tested in accordance with the appropriate IEC standard. Where no appropriate standard is available, tests shall be carried out in accordance with the maker's standard practice, subject to the prior approval of the Project Manager. In all cases, works tests shall include electrical mechanical and hydraulic tests in addition to any tests called for by the Project Manager to ensure that the plant being supplied fulfills the requirements of the Specification.

If considered necessary by the Project Manager any multi-part assemblies shall be fully erected in the Works prior to packing and dispatch to Site.

All tests to be performed during manufacture, fabrication and inspection shall be agreed with the Project Manager prior to commencement of the work. The inspection schedule included in the Schedules of Miscellany shall be used for this purpose. The Contractor shall prepare the details of the schedule and submit these to the Project Manager for approval.

It must be ensured that adequate relevant information on the design, code/standard employed, the manufacture/fabrication/assembly procedure and the attendant quality control steps proposed are made available to the Project Manager. The Project Manager will mark in the appropriate spaces his intention to attend or waive the invited tests, or inspections.

A minimum of 14 days notice in writing, of the readiness of plant for test or inspection shall be provided to the Project Manager by the Contractor in accordance with the following:

The Contractor shall submit to the Project Manager sequentially numbered applications for inspection which shall contain the following information.

- ☐ Contract number
- ☐ Contract title
- ☐ Contractors Name
- ☐ Inspection application number
- ☐ ☐Manufacturers name, address, telephone and telex numbers, plus name of manufacturers staff responsible for the testing and manufacturer's works order number.
- ☐ Location of tests
- ☐ Date of tests
- ☐ Description in full of Plant offered for inspection (Contractors order references alone are insufficient and unacceptable)
- ☐ Section of the Works for which Plant is allocated.
- ☐ Schedule of tests to be performed and standard to be applied.
- ☐ List of the Employer's approved drawing numbers appropriate to the Plant offered ☐
- Sub-order number

The subject items should remain available for the Project Manager inspection and test up to a minimum of 10 days beyond the agreed date of witnessing the test.

Every facility in respect of access, drawings, instruments, and manpower shall be provided by the Contractor and his Sub-contractor to enable the Project Manager or his designated representative to carry out the necessary inspection and testing of the plant.

No equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, and approved for shipment, or alternatively inspection has been waived. The Contractor shall request permission to dispatch in writing.

Functional electrical, mechanical and hydraulic tests shall be carried out on the completed plant after assembly in the works. The extent of these tests and method of recording the results shall be submitted to, and agreed by, the Project Manager in sufficient time to enable the tests to be satisfactorily witnessed, or if necessary for any changes required to the proposed programme of tests to be agreed.

All instruments and apparatus used in the performance of the tests shall be to the approval of the Project Manager, and, if required by the Project Manager, shall be calibrated to an agreed standard at the National Physical Laboratories or equivalent centre and approved by the Project Manager.

The cost of carrying out such calibrations shall be borne by the Contractor in all cases.

The Project Manager reserves the right to visit the Contractor's works at any reasonable time during manufacture of the items of plant and to familiarize him with the progress made and the quality of the work to date.

3.24.2 Test Certificates

Within 30 days of the completion of any test, four sets of all principal test records, test certificates and correction and performance curves for the plant and its component parts shall be supplied to the Project Manager.

These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Project Manager or his Representative. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the contract reference title. It shall be possible to identify the item of plant to which a specific test certificate refers, including those of sub-components and the specific site for which the item is allocated.

Contractors order numbers or drawing reference numbers are not sufficient for this purpose without a description of the plant involved.

Test certificate shall provide full details of the measurements of their tolerances, and actual test values obtained. Certificates simply stating phrases such as 'Passed' or 'Tested in accordance with' are not acceptable.

When all equipment has been tested, the test certificates from all works and site tests shall be compiled by the Contractor into volumes and bound in an approved form, complete with index and included in the appropriate operation and maintenance manuals.

B. CIVIL

**4.0 TECHNICAL REQUIREMENTS
FOR SUBSTATION CIVIL AND BUILDING WORKS**

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4.1 Introduction

This contract is being tendered as a turnkey contract, in which the selected contractor will be responsible for carrying out all civil works designs, including preparing working drawings and specifying materials to be used in all temporary and permanent works. This section describes the General Technical Requirements for all civil works, which include earthworks, the construction of foundations, structures, architectural features and all associated works required for REB 33/11 KV Indoor Rural Type Substations, fitting out structures, buildings and associated works, and erecting, installing and commissioning of all Substation plant. This section shall be read in conjunction with the Project Requirements, Schedules and Drawings.

The Contractor shall appoint a team of qualified and experienced engineers and other specialists to undertake the detailed design of all civil and associated works, and shall submit all completed designs, drawings and supporting calculations to the Project Manager for approval before site work commences.

4.2 Design and Construction Standards

The design and construction shall conform to the latest edition of the relevant codes of practice and standards listed below and in individual clauses in this document relating to specific materials or practice. Any proposed substitution for the listed standards by an equivalent standard shall be subject to approval by the Employer.

AASHTO	American Association of State Highway and Transportation codes for site access road design
ACI 318-89	Building Code Requirements for Reinforced Concrete
ASTM	American Society for Testing and Materials
BNBC	(Bangladesh National Building Code) with requirements for building works
BS 12	Portland Cement
BS EN 124	Gully and Manhole Tops for Vehicular and Pedestrian Areas
BS 812	Testing Aggregates
BS 882	Aggregates from Natural Sources for Concrete
BS 1387	Specification for Screwed and Socketed Steel Tubes
BS EN ISO 1461	Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles
BS 1881	Testing Concrete
BS EN 1992-1-1	Design of Concrete Structures (includes foundations)
BS EN 1997-1	Geotechnical Design
BS 2853	Design and Testing of Overhead Runway Beams
BS 3148	Methods of Testing for Water for Making Concrete
BS 3921	Clay bricks
BS 4449	Steel Bars for the Reinforcement of Concrete
BS 5262	External Renderings
BS 5395	Stairs, Ladders and Walkways
BS 5572	Sanitary Pipe Works
BS 5628	Code of Practice for use of Masonry
BS 5930	Code of Practice for Site Investigations
BS 6031	Code of Practice for Earthworks
BS 6367	Code of Practice for Drainage of Roofs and Paved Areas
BS 6399: Part1	Code of Practice for Dead and Imposed Loads
BS 6399: Part 2	Code of Practice for Wind Loads
BS 6465	Sanitary Installations
BS 6651	Code of Practice for Protection of Structures against Lightning
BS 6700	Design, Installation, Testing and Maintenance of Services Supplying Water for Domestic Use
BS 8004	Code of Practice for Foundations
BS 8005	Sewerage
BS 8100	Lattice Towers and Masts
BS 8102	Code of Practice for Protection of Structures Against Water
BS 8110	Structural Use of Concrete
BS 8206-2	Lighting for Buildings
BS 8215	Code of Practice for Design and Installation of Damp-proof Courses in Masonry
BS 8290	Suspended Ceilings
BS 8301	Code of Practice for Building Drainage

4.3 Units of Measurement

All designs and measurements in this Contract shall be provided in the International System of Units (SI) in accordance with the provisions of ISO 31 and ISO 1000.

4.4 New 33/11 kV Substations

Two storied buildings will be designed and constructed to establish a 33/11kV Substation with associated work including control room, complaint room, service road, fencing work, landscaping and beautification work and other related works.

The Contactor shall be responsible for the design and construction of the Substation and associated work, which will include the following:

- ☐ Topographical survey as part of site analysis
- ☐ Subsoil investigation, sampling and laboratory testing
- ☐ Master plan including services road, landscaping (beautification work) as per respective site condition
- ☐ Conceptual alternative studies of site plans shall be undertaken for individual sites, study and architectural planning of individual units. The site plan shall consider the building and other facilities/utilities like circulation roads, parking, utility networks, landscaping and boundaries.
- ☐ Foundation works
- ☐ Architectural plan, section, all side elevation including 3-D perspective of the building.
- ☐ Structural design as per present code of practices in Bangladesh (BNBC), detail drawings for construction works.
- ☐ All required temporary works.
- ☐ Earth works requirements as per site condition.
- ☐ Time schedule/work programme, BOQ including rates and all other document, Maintenance and Operation Manual as required for the process.

4.5 Site Analysis and Topographical Survey

The proposed substation sites are located as per drawing locations of Bangladesh. They are mainly in low lying areas and predominantly paddy land. The Contractor shall carry out a topographical survey of all substation sites prior to design work commencing, using the most modern survey equipment available in the country. The Contractor shall first establish a benchmark on or immediately adjacent to each site on a permanent structure, and establish its level relative to the nearest PWD benchmark. Detailed digital plans of each site shall be prepared using AutoCAD at a scale agreed by the Project Manager showing all existing physical features and other information as listed below and, to the extent necessary, the survey shall extend beyond the site boundaries to capture adjacent information:

- (a) contours at intervals agreed by the Project Manager, extending into the immediate surroundings of the site;
- (b) boundary line of the site;
- (c) above ground physical features such as roads, including the nearest National or other main road, tracks, structures, utilities and plantations;
- (d) the location of below ground utilities including piped water supply, gas, drainage, sewerage and tube wells;
- (e) the highest flood level (HFL) at the site and its surrounding areas, related to the benchmark;
- (f) the nearest points at which connections could be made to existing water, electricity and gas supplies, if available

4.6 Subsoil Investigations

Any previous soil test reports, if available, for each sub-station site will be provided by the Employer. However, the Contractor shall be fully responsible for all foundation design and must conduct his own subsoil investigations at every site, the main purpose of which is to determine, within practical limits, the stratification, ground water table and engineering properties of the soils underlying the sites of the proposed buildings. The principal properties of interest shall be the strength, bearing capacity and settlement characteristics of the underlying soils. Efficient, safe, economical design and construction can be achieved only through adequate evaluation of soil conditions of the proposed construction.

The Contractor may appoint a sub-contractor (if required) to carry out the site investigations but all work and all lab work shall be witnessed by one of his own staff who shall countersign all recorded data.

The record of all boring shall include but not limited to the following information: (a)

Size of the casing (if used)

- (b) Number of blows per 300mm required to drive the sampling spoon and data should be recorded every 1.5 m intervals.
- (c) The elevation of the ground surface referred to an established datum
- (d) Location and depth of boring and its relation to the proposed construction (e)
Elevation at which samples are taken
- (f) Elevation of the boundaries of soil strata
- (g) Description of soil strata encountered and any particular unusual or special condition such as loss of water in the earth and rock strata, boulders, cavities and obstructions, use of

special type of samplers, traps etc.

- (h) The level of ground water together with a description of how and when ground water level was observed

A minimum of five boreholes or augurs shall be drilled at each Substation site and if the results vary across the site, the Project Manager shall determine whether and how many additional boreholes shall be drilled.

4.7 Laboratory Testing

The following soil tests shall be performed in a laboratory approved by the Project Manager for evaluation of soil parameters:

- (a) Grain size analysis
- (b) Specific gravity
- (c) Unit weight (wet & dry) (d) Natural moisture content
- (e) Unconfined compression strength (f) Direct shear
- (g) Consolidation test

The Contractor's Soil Investigation Reports for each site shall propose full details of foundations and loading thereon and shall provide estimates of total settlements and differential settlements of the underlying soil deposits and substantiate the recommendations regarding type of foundation. The site investigations and analysis of the data in the Reports shall contain but not be limited to the following:

- (a) Location of ground water level
- (b) Bearing capacity of the soil
- (c) Comparison of alternative types and/or depths of foundation (d) Data on soil parameters and properties
- (e) Settlement predictions
- (f) Risks if any to property adjacent to the site.
- (g) End bearing value and skin friction for pile design

4.8 Bulk Earthworks

The existing level of all sites are below the HFL, in some cases by up to 5 m, and filling is required to raise the site level above HFL. The raised ground level of all sites shall be either 600 mm above the HFL or equal to the level of the nearest main road to the site, whichever is the higher, and also determined such that water shall not drain from the approach road or main road to the site. It is the Contractor's responsibility to determine the fill height required from the topographical survey data in accordance with the above criteria.

Slope protection works shall also be designed and carried out. This protection should be mainly by the construction of reinforced concrete retaining walls, pre-cast concrete piles or seasoned wooden piles, which shall be dependent on the height of filling required as well as existing sub-soil. The

Contractor may select and design the type of retaining wall considering the Soil Investigation Reports and the following:

- (a) RCC retaining wall shall be selected where the filling height is above 3.0 m. The foundation of the wall shall be dependent on the sub soil report.
- (b) Pre-cast pile shall be considered where the filling height between 2.0 m to 3.0 m. The spacing of the pile shall depend on the filling height and size of pile. A rectangular RCC pre-cast slab of size 1.0 m × 0.5 m shall be used and is to be fixed with the pile by proper bolting to retain the soil.
- (c) Seasoned wooden pile shall be considered where the filling height is below 2.0 m. A metal sheet with proper treatment shall be fixed with the pile by proper bolting to retain the soil. The spacing of the pile depends on the filling height and diameter of pile

The fill materials shall be deposited and spread in successive uniform horizontal layers of about 150mm thick and compacted by use of mechanical 1.5 ton “Vibro” compactor or other approved devices to a 98% standard dry density in road and pavement sub-base and 95% standard dry density for other areas. In filling /back filling against a newly constructed structure precaution must be taken so that the structure is well matured to take the thrust of filling and when filling against a wall, the filling shall be carried out from both sides simultaneously.

Tests shall be carried out at a recognized laboratory to ascertain the nature of the fill material and the degree of compaction obtained for the filled material for which samples shall be taken and transported to the recognized laboratory by the Contractor at his cost and as directed by the Project Manager.

4.9 Building Foundations

The type of foundations required will be selected and designed by the Contractor based on the results of the subsoil investigation and testing program at each new Substation site. The foundations may be either shallow (spread footings or mat) foundations or deep (pile) foundations according to subsoil conditions. The Contractor shall submit his foundation design with full supporting calculation for the approval of the Project Manager. Design shall be according to BS EN 1992-1-1 and BS EN 1997-1. If deep piles are required, the submission shall include full details of the type of pile (bored or driven) and the proposed construction sequence.

4.10 Civil Work

Each Substation shall be designed with a two storied control room building (with a foundation suitable for three stories) with an approximate floor area of 216 sq. m. per story.

- ☐ Ground Floor (Ceiling Height 3 m): Complaint Centre, Office Room, Rest Room and Toilet (02 Nos.).
- ☐ First Floor (Ceiling Height 3 – 3.7 m): 33 kV & 11 kV Switchgear, Control Room, Battery Room, Toilet (01 No.).
- ☐ Stair with two flights (run width = 25 cm, riser height = 15 cm and railing with SS/MS angle).
- ☐ Great beam height of control room building to be 60 cm above finished ground level.
- ☐ The outside wall of the control room building shall be covered with Ceramic Bricks and the floor of the control room shall be Mosaic finishing.

- ☐ One no. opening with shutter (20 cm wide and full first floor height) at the outer wall of the first floor of the control room building at a suitable position as per instruction of the Project Manager (for materials to be carried on the first floor or carried out from the first floor).
- ☐ Oil Containment bund walls – for oil drain out one tank to be provided along/beside the transformer pad.
- ☐ Cable Trench, Duct and Sump Pits: Cable Trench depth should be provided above flood level of that area i.e. we should be able to avoid water logging in the cable trench. Cable trench with cable tray made by rust protective material. Cable trench should be properly covered.
- ☐ RCC Retaining wall along the property line and matching main and personnel gates: RCC Retaining wall to be constructed along the property line of Substation area including matching main and personal gates. Structure and foundations for line landing gantries, plant and equipment. All foundations (including future provisional equipment foundations), ducts/ drainage, fencing and gates.
- ☐ 33/11 kV Transformer Foundation: Solid power transformer foundation may be considered in that case rail provision to be provided above x-former pad.
- ☐ FGL of substation yard should be 60 cm above the highest flood level.
- ☐ Substation yard surface finishing should be with 25 – 30 mm washed stone gravelling of 7-10 cm depth.
- ☐ Construction of internal roads (as required).
- ☐ Substation yard surface finishing should be with 1” – 1.25” washed stone gravelling of 4” depth.
- ☐ Supply and installation of Air Conditioning System for Control Room including all other accessories/ components required for fitting & fixing up to commissioning.
- ☐ Supply and installation of submersible water pump motor set for safe drinking water including borehole drilling, pipes and all other accessories/ components required for fitting & fixing up to commissioning.
- ☐ All necessary furniture for the Control Room.
- ☐ Supply and installation of security lights.
- ☐ Material test results used in construction works.

4.11 Design and Construction Requirements and Interchangeability

4.11.1 General Requirements

The Works shall be designed to operate safely, reliably and efficiently in accordance with the design and operating requirements stated in this Specification. No violation from the Specification shall be made subsequent to the Contract without the written approval of the Project Manager.

Each of the several parts of the Plant to be provided shall be of the manufacturer's standard design, provided that this design shall be in accordance with an international code of practice and generally in accordance with this Specification.

The design, dimensions and materials of all parts shall be such that they shall not suffer damage as a result of stresses under the most severe service conditions. The materials used in the construction of the Plant shall be of the highest quality and selected particularly to meet the duties required of them. The plant shall be designed and constructed to minimize correction. Workmanship and general finish shall be of the highest class throughout.

All plant items and corresponding parts performing similar duties shall be interchangeable in order to minimize the stock of spare parts.

All equipment shall be designed to minimize the risk of fire and damage which may be caused in the

event of fire.

4.11.2 Specific Requirements

The choice of plant and design of the installation is to meet the following criteria:

- (a) Sub-station layouts are to utilize the minimum of land area in the existing Substation.
- (b) All equipment is to facilitate the installation of all circuits indicated as “future” with the minimum of disruption. All cabling schemes, D.C. and A.C. equipment etc. shall be designed to accommodate all such future circuits and loads.
- (c) The plant and installation shall be designed for a minimum service life of 25 years.
- (d) All plant is to have a minimum of 2 years satisfactory and proven service record of high durability and reliability in a similar environment. Documentary evidence in support of the choice of any item of plant shall be provided by the Contractor if requested by the Project Manager.

Each sub-station is to be designed such that the failure or removal of any one item of plant for maintenance or repair shall not damage or hamper the operational integrity of the sub-station. The design and layout of the sub-stations shall ensure the safety of personnel concerned with the operation and maintenance of the plant.

4.12 Plant and Equipment Identification

4.12.1 Identification on Drawings

The Contractor shall prepare comprehensive plant and equipment Identification Schedules. Each item in the Schedules shall include the drawing number of the related flow sheet, diagram or drawing showing that item.

4.12.2 Labels and Nameplates

The Contractor shall supply and install labels, nameplates, ratings, instructions and warning plates, necessary for the identification and safe operation of plant and equipment at Substations.

Nameplates and labels shall be non-hygroscopic material with engraved lettering of a contrasting colour or, alternatively in the case of indoor circuit-breakers and starters, of plastic material with suitably coloured lettering engraved thereon.

All nameplates and labels shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives shall not be permitted. Individual plant items and all relevant areas within the contract works where a danger to personnel exists shall be provided with plentiful, prominent and clear warning notices. These warning notices shall draw attention to the danger or risk with words which attract attention and summarize the type of risk or danger. The notices shall also carry a large symbol which graphically depicts the type of risk.

All equipment within panels and desks shall be individually identified. The identification shall correspond to that used in schematic and wiring diagrams.

Each circuit breaker panel, electrical control panel, relay panel etc., shall have circuit designation label mounted on the front and rear. Corridor type panels shall additionally have circuit designation labels within the panels.

All equipment and apparatus mounted there on shall be clearly labeled in an approved manner. The function of each relay, control switch, indicating lamp, MCB, link etc. shall be separately labeled.

The Contractor shall be responsible for the relocation, or replacement of all labels on existing plant, which becomes inaccurate as a consequence of the contract works.

The language of labels, plates and notices shall comply with the requirements of the Contract.

4.13 Safety and Security

4.13.1 Interlocks

A complete system of interlocks and safety devices shall be provided so that the following requirements and any other condition necessary for the safe and continuous operation of the plant are provided:

- (a) Safety of personnel engaged on operational and maintenance work on the plant.
- (b) Correct sequence of operation of the plant during starting up and shutting down periods.
- (c) Safety of the plant when operating under normal or emergency conditions.
- (d) Interlocks shall be preventive, as distinct from corrective in operation.

Where plant supplied under this Contract forms the whole or a part of a system for which one or more interlocking schemes are required, the Contractor shall be responsible for designing all interlocking schemes and presenting them for the Project Manager's approval. General descriptions of interlocking requirements are given in the Specifications but the Contractor shall include for any other interlocks he considers necessary.

4.13.2 Locks, Padlocks, and Key Cabinets

The Contractor shall provide padlocks, locks, chains or other locking devices for the locking of all equipment cubicles, electrical isolating switches, selector switches, valves, etc. to the approval of the Project Manager.

All locking devices and chains shall be manufactured from corrosion resistant material. All mechanisms shall be provided with a cover to minimize entry of water or dust.

Locks shall conform to a master keying feature system to be agreed with the Project Manager for groups of equipment. All locks shall have individual high integrity locks and shall be provided with three (3) keys. Each key shall be provided with a label as specified.

The Contractor shall supply and fit key cabinets equipped with labeled hooks, each Identified with its appropriate key. Every cabinet shall be provided with a nameplate identifying the cabinet with its respective item or items of plant. Sufficient cabinets shall be provided to store all keys supplied under this Contract and cater for future extensions.

The Contractor shall provide comprehensive lock and key schedules to readily permit identification with equipment and doors. Such schedules are not required for loose padlocks.

Where modifications are performed to existing sites the Contractor shall provide a system identical to that existing.

4.14 Commissioning Spares

In addition to the spare parts being provided to the Employer, the Contractor is responsible for ensuring that he has access to a stock of commissioning spares. Spares provided to the Employer are not to be utilized as commissioning spares without written approval of the Project Manager, in which case the Contractor shall immediately replace the contract spares at his own expense.

All commissioning spares are considered as Contractors equipment.

4.15 Consumable Items

4.15.1 Chemicals and other Consumable

The Contract includes for the provision of all chemicals, resins, and other consumables required for testing, commissioning and setting to work of each section of the works.

Unless otherwise stated, the Contractor shall provide all such chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period of 12 months for each section of the works from the date of the final certificate.

The Contractor shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.

4.16 Painting and Cleaning

Immediately following signing of the contract, the Contractor shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for a contract shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility.

Painting of the plant shall be carried out in accordance with the appropriate schedule. The work is generally covered by the schedules but where particular items are not referred to specifically, they shall be treated in a manner similar to other comparable items as agreed with the Project Manager.

The schedules indicate standards of surface preparation and painting which is intended to give a minimum service life of 10 years in a coastal industrial environment, with need for minor remedial work only during that period.

Steel sections and plate shall be free from surface flaws and laminations prior to blast cleaning and shall not be in worse condition than Pictorial Standard B, Swedish Standard SIS 05 5900.

The Project Manager will consider alternative paint schemes to meet the requirements of fabrication using modern automated materials handling systems, provided they offer the same standards of surface protection and service life as those intended by the schedules.

All paints shall be applied by brush or spray in accordance with the schedule, except for priming coats for steel floors, galleries and stairways where dipping is permitted.

Where paint is to be applied by spray, the applicator shall demonstrate that the spray technique employed does not produce paint films containing vacuoles.

Where paint coatings are proposed for the protection of surfaces of equipment exposed to corrosive conditions, such as plant items exposed to brines or sea water immersion in liquid, or wet gases, the coatings shall be formulated to be suitably corrosion resistant and shall be high voltage spark tested at works and/or at site prior to commissioning. The test procedure shall be based on the use of a high voltage direct current. The voltage used shall be 75% of the breakdown voltage of the coating. This breakdown voltage shall first be separately determined using test plates coated with the specified coating formulation and thickness. The coating on the test plate shall also be micro-sectioned by the applicator to show that it is free from vacuoles and other defects likely to invalidate the test procedure.

If the defects revealed by the above test procedure do not exceed one per 5 m² of coating surface, the coating need not be re-tested after the defects have been repaired. If the defects exceed one per 5 m² of coating surface, the repairs shall be resettled after any curing is completed, and this procedure shall be repeated until the defects are less than one per 5 m² of coating surface. After repair of these defects, the equipment can be placed in service without further testing.

All coating proposed for the internal protection of domestic water storage tanks and shall be certified by an approved independent Authority as suitable for use in potable water installations and shall meet the non-painting requirements of BS 3416.

All planished and bright parts shall be coated with grease, oil or other approved rust preventive before dispatch and during erection and this coating shall be cleaned off and the parts polished before being handed over.

Where lapped or butted joints form part of an assembly which is assembled or part assembled prior to final painting, the jointed surfaces shall be cleaned free from all scales, loose rust, dirt and grease and given one brush applied coat of zinc phosphate primer before assembly.

Paint shall not be applied to surfaces which are superficially or structurally damp and condensation must be absent before the application of each coat.

Painting shall not be carried out under adverse weather conditions, such as low temperature (below 40° C) or above 90% relative humidity or during rain or fog, or when the surfaces are less than 30° C above dew point, except to the approval of the Project Manager or his duly appointed representative.

Priming coats of paint should not be applied until the surfaces have been inspected and preparatory work has been approved by the Project Manager or his duly appointed representative.

No consecutive coats of paint, except in the case of white, should be of the same shade. Thinners shall not be used except with the written agreement of the Project Manager.

On sheltered or unventilated horizontal surfaces on which dew may linger more protection is needed and to achieve this additional top coat of paint shall be applied.

The schedules differentiate between ‘Treatment at Maker’s Works’ and ‘Treatment at Site after Completion of Erection’ but the locations at which different stages of the treatments are carried out may be modified always providing that each change is specifically agreed to by the Project Manager and the painting is finished at site to the Project Manager’s satisfaction.

All paint film thickness quoted are minimum and refer to the dry film condition. All thickness shall be determined by the correct use of approved commercial paint film thickness measuring meters.

The Contractor shall ensure that precautions are taken in packing and crating to avoid damage to the protective treatment applied before shipment, during transport to the site.

Structural bolts shall be galvanized, sherardized or cadmium plated and painted as for adjacent steelwork.

All structural timber that does not require to be painted (timber joists, flooring, etc.) shall be treated with two coats exterior grade approved timber preservative.

The requirements of this clause and the schedules shall be interpreted in accordance with the requirements and recommendations of BS 5493 and CP 231, 3012 and the paint manufacturer’s special instructions where applicable.

Colour shall be in accordance with BS 1710 and BS 4800 or equivalent national standards.

4.17 Galvanized Work

All galvanizing shall be carried out by the hot dip process and unless otherwise specified, shall conform in all respects with IEC’s.

Attention shall be paid to the detail of members, (in accordance with IEC’s). Adequate provision for filling venting and draining shall be made for assemblies fabricated from hollow sections. Vent holes shall be suitably plugged after galvanizing.

All surface defects in the steel, including cracks, surface laminations, laps and folds shall be removed (in accordance with IEC’s). All drilling cutting, welding, forming and final fabrications of unit members and assemblies shall be completed before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from welding slag, paint, oil, grease and similar contaminants.

The coating shall be as specified in BS EN ISO 1461 or equivalent National standard. Structural steel items shall initially grit blasted to BS 4232, second quality (SA2.5). The minimum average coating weight on steel sections 5 mm thick and over shall be as specified in BS EN ISO 1461.

Bolts, nuts and washers, including general grade high strength friction grip bolts (referred to in BS 3139 and BS 4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to BS 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of a galvanized high strength friction grip bolt after the bolt has been inserted through the steelwork shall be allowed to come into contact with the faying surfaces.

During off-loading and erection, nylon slings shall be used. Galvanized work which is to be stored in works on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (with rust).

Small areas of the galvanized coating damaged in any way shall be brought to the attention of the Project Manager who shall authorize repair by cleaning the area of any weld slug and through wire brushing to give a clean surface, and application of two coats of zinc rich paint or the application of low melting point zinc alloy repair rod or power to the damage area, which is heated to 300⁰C.

After fixing, bolt heads, washes and nuts shall receive two coats zinc rich paint.

4.18 Steel Pipe Work

All steel piping shall be designed, manufactured and tested in accordance with British Standards or equivalent National Standards approved by the Project Manager. In particular, the minimum wall thickness of steel pipe work shall comply with Table 2 of BS 1387.

Drains and air vents shall be provided as required by the physical arrangement of the pipe work and shall be via valves with the drain and vent pipe work led to drain points to the approval of the Project Manager.

Screwed pipe work systems shall be provided with adequate unions to enable valves and fittings to be removed if required with minimum disturbance to the rest of the pipe system.

4.19 Bolts, Studs, Nuts and Washers

All bolts and nuts shall conform dimensionally to the requirements of BS 3092 or BS 4190 or equivalent National Standard.

The Material of all bolts, studs and nuts for piping systems shall conform to the requirements of BS 4505 or equivalent National Standard.

The threaded portion of any bolt or stud shall not protrude more than 1.5 threads above the surface of its mating nut.

When fitted bolts are used they shall be adequately marked to ensure correct assembly.

Bolts, nuts, studs and washers in contact with sea water or used on pipe work systems containing sea water shall be of the same material as flanges etc.

The use of slotted screws shall be avoided; hexagon socket screws or recessed type heads shall be used.

4.20 Architectural and Structural Requirements of Buildings

4.20.1 Architectural Planning and Design

All new buildings and extension to existing buildings shall be designed to be architecturally pleasing in appearance to the satisfaction of the Employer and to withstand the tropical climate with minimal maintenance.

Architectural plan and elevations of all sides of buildings shall be agreed with the Project Manager before other details are finalized. All external walls shall be 230 mm first class brick work plus a 50 mm thick layer of Mirpur ceramics facing bricks or similar approved for 10 MVA new sub-station building as required by the architectural drawing. The internal walls shall be 105 mm thick first class brick work with plastered and painting of an approved color. For the 5 MVA substations building internal walls shall plastered with paint finishing.

Bath room floors, walls and stairs shall be tiled. A fixed ladder of galvanized steel shall be provided up to the roof considering the future provision. Window frames shall be aluminum with MS grill. Doors shall be wooden and water proofed. A rolling shutter door with a ramp shall be provided for 10 MVA Substation buildings.

The main entrance to all buildings shall be shaded, either by a projection of the roof over the entrance verandah or by a separate roof at a lower level. This area of roof shall also be lime terraced and drained by rainwater pipes.

The service facilities like electricity, water supply and sanitary works, sewerage, gas connection (if possible) etc. shall be provided as per requirements. Best quality fitting and fixture made in Bangladesh shall be provided in bathroom in kitchen room. Electrical fittings and fixtures shall be best quality and wiring provided in Substation buildings shall be internal. Samples shall be shown to and approved by the Project Manager.

4.20.2 Structural Design

Structural design of Substation buildings shall be according to the Bangladesh National Building Code (BNBC). Loads for reinforce concrete design shall be calculated as the sum of dead loads, live loads and environmental loads (wind and seismic) as explained in the BNBC. Ultimate Strength Design (USD) method (BNBC Chapter 6) shall be adopted for design of all reinforce concrete structural elements.

The roof shall be a cast in situ concrete slab designed for 2.5 kN/m² live load. The ground floor slab shall be cast as per cable trench layout which shall be considered as slab on grade (RBC floor).

4.21 Utility Services

Utilities shall be designed and installed comprising:

- (a) Plumbing system including wastewater and surface water drainage system development including septic tank, soak well, and surface or buried drain.
- (b) Water supply and sanitary work.
- (c) Electrical works includes internal wiring, fitting, fixing all necessary items, internal lighting, street lighting, necessary earthing.
- (d) Telephone if needed.

4.22 Fire Detection and Protection Facilities

The Contractor shall design, manufacture, deliver to the Site, install, test and commission the firefighting system to protect each Substation, all plant associated equipment and outdoor yard. In particular, the following shall be included:

- (a) Fire Detection and Alarm system: fire detection shall be by means of smoke detectors and ultra violet flame detectors with a backup system utilizing rate-of-rise temperature detectors, along with an alarm system.
- (b) Balancing, testing and commissioning of fire detection and alarm system for 16 zone. (c) Dry chemical powder and carbon dioxide type fire extinguishers.
- (d) Five wall mounted sand buckets outside the control room building at suitable place locations

A reinforced concrete fire wall is required between two transformers in future provision for 10 MVA substations. The wall size shall depend on the transformer size. The Contractor shall prepare proposed designs for approval of the Project Manager.

4.23 Grid Substation Sending End Bays for New Substations

Some of the new Substations shall have direct connections from grid substations. Bays and busbar must be available for facilitating this connection. Where existing bay and busbar space is not available, new bays shall have to be designed and constructed and the existing busbar extended.

The Contractor shall be responsible for designing and constructing the grid substation foundation for 33KV circuit breaker, CT, gantry extension to construct new feeder bays and bays extension including earth grid where required including installing bay equipment and associated works. The design and drawings shall be submitted for the Project Manager's approval before any work commences at site.

4.24 Preparation of the Site

Boundary pillars of standard designs shall be fixed on the ground to define the boundary of the site.

Refuse or superfluous earth on the site shall be removed before construction begins. Shrubs and stumps of trees shall be uprooted and removed off site. Any valuable material derived from the clearing of the site should be stored and disposed of according to the BNBC.

No tree shall be cut down or pruned unless prior approval is given by the Project Manager. A survey report must be submitted and sanctions obtained before the trees are disposed of. If white ants are found to exist in the trees, their nests shall be located and dug up and the queen ant be destroyed. Holes left after uprooting of the trees shall be backfilled with sand or earth, care being taken that the fill, on compaction, achieves the density of the surrounding soil.

The Contractor's Engineer himself shall set out all important levels for permanent works using the site benchmark established during the topographical survey. Areas for storage and stacking of materials should be set out and pegged, similarly the position of temporary buildings, the access road and site roads.

The Contractor shall not fell any tree outside the site boundary without the express written permission of the land possessor, even if such tree is an obstacle to execution of the work.

4.25 Temporary Buildings on Site

Locations of temporary offices, guard sheds, work sheds and accommodation on each site shall be selected such that they do not clash with the location of permanent work and do not interfere with

construction work. Prefabricated buildings that are simple to erect and dismantle, yet provide a pleasing look, are preferred.

4.26 Access to the Site

The access road to each site shall generally be of the shortest possible length from the nearest main road. While designing the road alignment, the Contractor shall maximize natural slopes as much as possible for drainage of rainwater and the facilities shall be secured effectively and economically. The design and drawings shall be prepared by the Contractor to current practices AASHTO codes of practice.

4.27 Site Drainage

The entire surface of each Substation site within its boundary walls shall slope at 1 in 150 minimum gradient to open channels around the entire perimeter. These channels shall be designed for a rainfall intensity of 60 mm per hour. Outside the boundary wall, the Contractor shall be responsible for drainage up to 20 meters, or to suit each sites requirements, from the wall and the drainage outlets at some sites may be need to be provided with suitable erosion protection down to paddy level.

The ground immediately adjacent to foundations shall be sloped away from them at a slope of not less than 1:12 for a minimum distance of 205 m measured perpendicular to the toe of the wall. Consideration shall be given to possible additional settlement of backfill when establishing the final ground level adjacent to foundation.

A 75 mm layer of crushed rock (average size 30 mm) shall be placed across the entire site, extending 1 m outside the fence.

The concrete wall of cable trenches shall project at least 70 mm above brick paving level to prevent run off entering the cable trench. The floors of all cable trenches or tunnels shall be sloped to soak aways.

The cable trenches shall be free from surface water drainage. If the cutoff area exceeds 30 m² it shall be drained by a concrete pipe sized to take the runoff to the boundary drain. The Contractor's drainage design shall avoid all ponded water to avoid forming a mosquito breeding ground.

All drainage pipe work except cable trenches within buildings shall be UPVC pipe of diameter as per design requirement. But cable trenches are RCC work as per design requirements.

The floor slab shall be constructed in reinforced brick concrete (RBC) floor 125 mm thick and foundations for controlling equipment in RCC.

External pipe work shall be 150 mm minimum diameter concrete pipes at a minimum depth of invert of 600 mm. Where pipes, including existing pipes along with site, are less than 400 mm above adjacent foundations, they shall be surrounded in concrete. Where required, drainage pipes shall be kept below cables, allowing 1.1 m cover to the top of pipes.

Manholes shall be of brick construction with 500mm x 500mm clear openings and air tight ductile iron covers to BS EN 124. Manholes shall be located at all changes of pipeline direction. The minimum gradient for all pipelines shall be 1 in 80. Manholes shall not be located in roads.

The Contractor shall be responsible for all negotiations with local authority (WASA) where a connection to a public sewer is proposed. The Contractor shall provide all protection required to

existing sewers and shall deepen foundations, including boundary wall foundations, where required all foundations are below adjacent sewers.

Each control building shall be provided with a septic tank designed for 10 users and a soakaway of open brick construction 11 m deep by 2.2 m diameter filled with broken bricks. The septic tank shall be located at suitable place of the area. The inner surface of all manholes and septic tanks shall be painted with two coats of bitumastic paint to protect it against sulphate attack. The septic tank shall have access holes directly over the inlet pipes and outlet pipes. Where public sewers exist along the side of substation site, the Contractor shall connect directly to the sewerage line from the soakaway. Two vents of minimum height 2.2 m shall be provided on each septic tank.

4.28 Site Maintenance during Construction

- a) The site shall be kept as clean as reasonably possible during construction. Materials shall not be stacked haphazardly but kept in a planned manner in proper stacks. Care shall be taken to maintain the site with proper drainage of rain and stagnant water.
- b) The proposed roads should be laid out and used for carriage of materials to avoid vehicles travelling randomly over the site and spoiling it. The base of the road may also be laid and maintained during construction.
- c) Any rejected materials, dismantled materials and other items not required in the construction shall be removed from the site immediately, so that there is no chance of it being used by the Contractor's labour.

B.CIVIL

5.0 SUBSTATION BUILDINGS AND ANCILLARY FACILITIES

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5.1 Civil Works-General

This specification has been prepared with all possible care and diligence and every effort has been made to cover all types of materials and items of works necessary to complete the Project in all respect.

All workmanship and materials to be used in the Works shall be of the best quality of their respective kinds as specified herein. All materials used in the Works shall be new and obtained from the sources and suppliers approved by the Project Manager. Materials shall comply strictly with the requirements prescribed hereinafter or, where such requirements are not specified in this specification, the latest issues of the relevant Technical Standard shall be followed. All tests of materials shall be done by laboratory approved by the Project Manager. The accuracy and sufficiency of information furnished in this specification is not guaranteed. It is the responsibility of the Contractor to clear any confusion or ambiguity in this specification well ahead of submission of bid. In case of any missing item relevant standard specification shall be followed.

5.1.1 Materials

5.1.1.1 Cement

Cement shall be Ordinary Portland Cement conforming to the requirements of the Standard Specifications for Portland Cement Type -I, ASTM C-150 or BDS 232 (2nd Revision) unless otherwise specified.

Cement shall conform to the following standards as per BDS 232 (2nd Revision) and ASTM C109, C191, C204.

a) Water for normal consistency	:	26% to 33%
b) Fineness	:	Minimum 280 sq. m./kg (by air permeability method)
i) Initial setting time, ASTM C191 ii)	:	Not less than 45 min.
Final setting time, ASTM C191	:	Not less than 375 min.
c) Minimum compressive strength i)		
3 rd day	:	
ii) 7th day	:	9.45 Mpa (1350 psi)
iii) 28th day	:	14.7 Mpa (2100 psi)
	:	21.0 Mpa (3000 psi)

Cement shall be delivered in packages as packed by the Manufacturer with the brand name, type of cement and weight of each bag marked on the bag. Sample test of cement must be done by laboratory approved by the Project Manager: Two bags from each brand or each consignment of supply of 25 metric tons of cement shall be selected for testing. The Project Manager require the Contractor to have the cement tested or can take samples in the presence of Contractor from cement bags stored at work site and send them to an approved laboratory for testing.

Cement of doubtful quality shall not be used until satisfactory results are obtained. All cement not conforming to specifications and cement that has deteriorated, been damaged or has set shall not be used and shall be immediately removed from work site by the Contractor. The cost of all such cement shall be borne by the Contractor.

5.1.1.2 Brick

Common building clay bricks shall conform to BDS 208 (First Revision).

Bricks shall be manufactured from combination of clay mixed with silica sand and alumina and shall be uniformly burnt throughout. Bricks shall be kiln burnt.

First Class Bricks

First Class Bricks shall comply with the following requirements of BDS 208 (Common Building Clay Bricks –First Revision)

- a) Bricks shall be of machine mould, uniform colour, shape and size having sharp square sides and edges and paralleled faces.
- b) Bricks shall be sound, hard and well burnt homogeneous in texture and free from flaws and cracks.
- c) Bricks shall emit a clear metallic sound when struck with a small hammer or another brick. A fractured surface shall show a uniform compact structure free from lumps, grits or holes.
- d) A first class brick shall not absorb more than $1/5^{\text{th}}$ of its dry weight when immersed in water for 24hours.
- e) A first class brick shall not break when struck against another brick or when dropped at T-position on hard ground from a height of about 1.2 meter.
- f) Standard dimension of bricks shall be 240 x 115 x 70mm (9.5" x 4.5" x 2.75") g)
Allowable variations in dimensions shall be:
 - i) in length not more than 6 mm ii)
 - in breadth not more than 5 mm iii) in
 - height not more than 1.5 mm
- h). Unit weight of bricks shall be minimum 1100 kg/cum
 - i) Minimum compressive strength of bricks shall be for i)
Halved bricks (mean of 12 bricks): 28 Mpa (4000 psi) ii)
Individual brick: 21.1 Mpa (3000 psi)
- j). Range of efflorescence for a first class brick shall be slight to nil.

Picked Jhama Bricks

Picked Jhama-Bricks shall be over-burnt First Class Bricks, uniformly vitrified throughout with good shape, hard slightly black in colour, and without cracks or spongy areas. Minimum compressive strength shall not be less than 28 N/mm² (4000 psi)

All other requirements for First Class Bricks shall apply to Picked Jhama except for dimensions.

Perforated Bricks

Perforated bricks shall meet the following specifications:

- a) Minimum unit weight : 3.00 kg/brick
- b) Minimum compressive strength on gross area:
 - i) Multi-core brick : 70kg/sq.cm
 - ii) 10-Hole engineering brick : 210kg/sq.cm
 - iii) Maximum size of perforation : 25sq.mm
- c) Minimum number of perforation
 - i) Along width of brick : 2

ii) Along length of brick d)	:	6
Minimum wall thickness:		
i) Between brick edge and perforation	:	10mm
ii) Between adjacent perforations e)	:	10mm
Maximum water absorption		
i) 5hrs, boiling	:	20% of dry wt.
ii) Efflorescence	:	Nil

Dimensions (3mm) 24cm × 11cm × 7cm (9.5" × 4.5" × 2.75")

The perforations may be of any regular shape in cross section, In case of rectangular section the larger dimension shall be parallel to length of the brick. Dimension of perforation measured parallel to the plane of the shorter side shall not be more than 15cm except in case of circular shape of the perforation in which case it may be allowed up to 20 cm. Total area of perforation shall not exceed 45% of the total area of corresponding face of the brick.

Clinker Bricks

Clinker bricks or tiles shall meet the following requirement:

Minimum unit weight	Minimum	:	2 kg/brick
compressive strength	Minimum	:	560 kg/sq.cm (8000psi) :
modulus of rupture	Water	:	560 kg/sq.cm (600psi) :
absorption 5 hrs. boiling		:	12%-15% of dry wt.
Efflorescence		:	Nil
Dimensions		:	200 mm x 100 mm x 5 mm (8" × 4" × 2")

Clinker bricks shall be manufactured by dry process and burnt to a higher temperature and shall uniformly vitrified to a dark copper tone. Edges shall be square, straight and sharply defined.

5.1.1.3 Sand (Fine Aggregate)

Sand shall conform to BDS 243, ASTM C 33

Sand shall be either natural sand, composed of clean, hard, durable uncoated particles resulting from the disintegration of siliceous and/or calcareous rocks; or manufactured sand resulting from the crushing of boulders or shingle.

The maximum size of the particles shall be 4.75 mm (3/16 in) and shall be graded down.

Sand shall be clean and free of injurious amounts of organic impurities; deleterious substances shall not exceed the following percentages by weight:

Clay Lumps and friable particles-Maximum	3%
Coal and Lignite	0.25%
Material passing the 0.075mm (No. 200) sieve	1%
Shale, coal, soft or flacky fragments	1%
Sulfur compounds	0.3%
Organic material content	no organic material.

Sand shall be well graded from coarse to fine and shall conform to the following Fineness Modulus:

Concrete	:	2.5	(Two point five)
Concrete	:	1.5	(One point five)
Mortar	:	1.5	(One point five)
Filling sand	:	1.0	(One point zero)
	:	0.8	(Zero point eight)

Sand from different sources of supply shall not be mixed and stored in the same stock pile nor used alternately in the work without permission from the Project Manager.

5.1.1.4 Coarse Aggregate

Coarse aggregate shall conform to BDS 243 (Coarse and Fine Aggregates from Natural Sources for Concrete 1; ASTM C 33: Concrete Aggregates).

Nominal maximum size of coarse aggregate in concrete shall not be larger than:

- a) One-fifth of the narrowest dimensions between sides of forms; or b)
One-third the depth of slabs; or
- c) Three-fourth the minimum clear spacing between individual reinforcing bars or wires, bundles of bars.

The Boulder

The boulders to be used for coarse aggregate in concrete shall be composed of limestone, sandstone, granite, trap rock or rock of similar nature and shall have the following properties.

Compressive strength (minimum)	35Mpa (5000psi)
Specified gravity	2.2-2.6
Unit weights	22-25.1 kn./cum
Porosity	2.10%
Water absorption (maximum)	2.5% by wt

The boulder shall be of uniform light color as approved and shall be free of thin laminations, adherent coatings, and deleterious substances. The wear loss of coarse aggregate of all types shall not exceed 35% by weight when tested by the Los Angeles Abrasion Test.

5.1.1.5 Water

The water used in mixing and curing concrete shall be tested for chlorides and sulphates in a standard material-testing laboratory as directed by Project Manager. The maximum acceptable limits shall be as follows:

- 1000mg/l as SO₃ for sulphates
- 500mg/l as Cl ion for chloride

Water shall be clear and free from salt, oil or acid, vegetable or other substances injurious to the finished product. The pH values of water shall generally be not less than 6. Water used in construction work shall be potable.

5.1.1.6 Admixtures

Admixtures used for the purpose of modifying the normal plastic life of concrete mix or for influencing its rate of gaining hardness and strength or for the workability of concrete shall not be used except with the written approval of the Project Manager.

Admixture if specified or permitted shall conform to the requirements of AASHTO Standard Specification M-194/ASTM, C-494 or ASTM C-1017.

It shall be kept in mind that a small change in the amount of admixture may cause great change in their action and their adequacy of performance is difficult to measure at the construction site during the progress of work. Water reducing admixture, accelerating admixture, water reducing and retarding admixtures, water-reducing and accelerating admixtures shall conform to ASTM C-494 (Chemical Admixtures for Concrete) or ASTM C-1017 (Chemical Admixtures for use in producing flowing Concrete)

5.1.1.7 Reinforcing Bar

High tensile steel reinforcing bar shall be structural grade deformed bar specified as per ASTM, A615M, and BOS 1313: 91, Bars having minimum yield levels of 275 Mpa (40,000 psi) and 415 Mpa (60,000 psi) are designated as Grade 40 and Grade 60 respectively. High tensile steel reinforcing bars shall meet the following strength test requirements:

Properties	Grade 40	Grade 60
Yield strength (minimum)	275 Mpa (40000 psi)	415 Mpa (60000 psi)
Ultimate strength (minimum)	483 Mpa (70000 psi)	620 Mpa (90000 psi)

Tolerance on Mass

Nominal size (mm)	Tolerance of mass per Meter run (%)
Up to 7	□ 8.0
8 to 12	□ 6.0
Over 12	□ 4.5

Tolerance on Diameter

Tolerance in diameter for both plain and deformed bars shall not exceed 2.5% for 12mm and less size and 1.8% for sizes larger than 12 mm.

Tensile Requirements

		Grade 40	Grade 60
	Tensile strength, min. psi	70000	90000
	Yield strength min. psi	40000	60000
	Elongation in 8 in min. %		
Bar Nos.			
3 (10mm)		11	9
4, 5, 6 (12, 16, 20 mm)		12	9
7, 8 (22, 25 mm)		...	8
9, 10 (28, 32 mm)		...	7
11, 14, 18 (35, 45, 57 mm)		...	7

Bending Requirements

The bend-test specimen shall withstand being bent around a pin without cracking on the outside of the bent portion. The requirements for degree of bending and sizes of pins are prescribed in Table 3 -Bend Test Requirement.

The bend test shall be made on specimens of sufficient length to ensure free bending and with apparatus which provides.

- ☐ Continuous and uniform application of force throughout the duration of the bending operation.
- ☐ Unrestricted movement of the specimen at points of contact with the apparatus and bending around a pin free to rotate.
- ☐ Close wrapping of the specimen around the pin during the bending operation.

Bend Test Requirements

Bar Designation No.	Pin diameter for Bend Test ^A	
	Grade 60	Grade 40
3,4,5	$3\frac{1}{2}d^b$	$3\frac{1}{2}d$
6	5d	5d
7,8	5d	--
9,10	7d	--
11	7d	--
14,18 (90 ⁰)	9d	--
Test ^A bends 180 ⁰ unless noted otherwise. d ^b = nominal diameter of specimen		

Frequency of Tensile, Bend, Rebend testing

Nominal size of bar (mm)	Value of x (Quality of materials in tones)		
	Tensile test	Bend test	Rebend test
Under 10	25	50	50
10 to 16	35	70	70
20 to 32	45	90	90

For the specified tests sample length shall be 600 mm long or 20 times the nominal size whichever is greater. Sample shall be selected from each batch at a frequency of not less than one up 5 (five) tones or part thereof where x has the value given in the above table. Samples from the bend and rebend tests shall not be selected from the same bar.

Cross Sectional Area and Mass

Nominal size	Mass (kg/m)	Cross sectional are (mm ²)
6 mm	0.222	28.30
8 mm	0.395	50.30
10 mm	0.616	78.50
12 mm	0.888	113.00
16 mm	1.579	201.00
20 mm	2.466	314.00
22 mm	2.980	380.00
25 mm	3.854	491.00
28 mm	4.830	616.00
32 mm	6.313	804.00

All steel bars prior to its use shall be cleaned with wire brush to make it free from loose scale, dirt, paint, oil, grease or other foreign substances.

All reinforcing steel shall be stored properly under shed not to be contaminated by oil, grease or mud.

Requirement for Deformation in Reinforcing Steel

The requirement of deformation shall meet ASTM A615.

- Deformations shall be spaced along the bar at substantially uniform distances. The deformations on opposite sides of the bar shall be similar in size and shape.
- The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45⁰ deg. Where the line of deformations forms an included angle with the axis of the bar of from 45⁰ to 70⁰ deg inclusive. The deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is over 70⁰ deg. a reversal in direction is not required.
- The average spacing or distance between deformations on each side of the bar shall not exceed seventeenth of the nominal diameter of the bar.
- The overall length of deformations shall be such that the gap between the ends of the deformations on opposite sides of the bar shall not exceed 12.5% of the nominal perimeter

of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25% of the nominal perimeter of the bar. Furthermore, the summation of gaps shall not exceed 25% of the nominal perimeter of the bar. The nominal perimeter of the bar shall be 3.14 times the nominal diameter

- e) The spacing/height and gap of deformations shall conform to the requirements prescribed in Table 1 of ASTM A615.
- f) Any bar that fails to satisfy the above requirements is to be treated as plain reinforcement according to ACI Building Code Requirements for Reinforced Concrete ACI 318-95.

5.1.1.8 Timber for Doors/Windows

Timber for doors shall conform to BDS 142; specification for Wood Doors (under revision): BDS 820, Recommendation for maximum permissible moisture content of timber used for different purpose in Bangladesh.

Timber used for doorframe and leaf shall be well-seasoned, dry and straight grained, free from knots and other defects affecting its appearance, strength and durability. All timbers used for doors/windows shall be mechanically seasoned and the moisture content shall not be more than 12-13%.

5.1.1.9 Aluminum Sections

All Aluminum Sections shall conform to U.S. Architectural Aluminum Manufacturers Association Standards (AAMA).

The following are the standards to be followed for Aluminum doors, windows and curtain walls or as specified in Bill of Quantity:

Channel thickness for doors	: 1.8 -2.5mm
Channel thickness for windows	: 1.2 -1.8mm
Anodization thickness	: 15 microns
Density of anodization	: 4mg per sq.m.

5.1.1.10 Glass

- ☐ Glass for aluminum door and window tinted or clear should be 5mm thick and there should be no undulations
- ☐ For smaller wooden panel/M.s. glazed shutters glass should be 3mm thick and there should ☐ be no undulations.

5.1.1.11 M.S. Pipe

M.S. pipe shall be made from low carbon steel conforming to ASTM A53 and following physical requirements:

Nominal Pipe Diameter	Wall Thickness (mm)	Inside Diameter (mm)	Outside Diameter (mm)	Weight (kg/m)
150 mm	7.11	154.08	168.30	28.26
100 mm	6.02	102.36	114.40	16.07
75mm	5.49	77.92	88.90	11.29
50mm	3.91	52.48	60.30	5.44
25mm	3.38	26.64	33.40	2.50
20mm	2.87	20.96	26.70	1.69
12mm	2.77	15.76	21.30	1.27

5.1.1.12 UPVC Pipe

UPVC pipe shall be of Unplasticised Polyvinyl Chloride (UPVC) and shall conform to the following specifications:

Specific Gravity	:	1.36 -1.43
Tensile strength	:	$450 \text{ Kg/Cm}^2 - 560 \text{ Kg/Cm}^2$
Elongation	:	80%
Compressive Strength	:	$600 - 700 \text{ Kg/Cm}^2$

Nominal Size		Mean outside Diameter (MM)		Schedule 40 Wall Thickness (mm)		Schedule 80 Wall Thickness (mm)	
Inch	(mm)	Min	Mix	Min	Mix	Min	Mix
2.00"	50	60.17	60.47	3.91	4.42	5.54	6.20
3.00"	75	88.70	89.10	5.49	6.15	7.62	8.53
4.00"	100	114.07	114.53	6.02	6.73	8.56	9.58
5.00"	125	141.05	141.55	6.55	7.34	9.52	10.66
6.00"	150	168.00	168.56	7.11	7.79	10.97	12.29
8.00"	200	218.70	219.46	8.18	9.17	12.70	14.22

5.2 Mobilization and Preparation of the Site

Description

This item shall consists of mobilization of man powers, materials & equipment and preparation of site by clearing off of the site of rubbish of all kinds including surplus earth, slurry, weeds, grass etc., cutting and uprooting of trees of all girth; removal of drains, dewatering & bailing out of water, during whole construction period, sewers or any other services, leveling of site including filling, if necessary, protection of the periphery of the site by earth to prevent passage of any outside rain and waste water etc. dismantling of existing structure if any, and removal of surplus materials and debris to a safe distance as directed by the Project Manager.

Construction Requirement:

Before setting out the new work and commencing foundation work the site must be cleared off of all those described above. On clearance of site it should be roughly leveled as required.

The trees shall be cut and their roots totally up-rooted as directed by the Project Manager. No tree should be cut unless it is absolutely unavoidable. All serviceable materials obtained from the clearing shall be property of the competent authority as determined by the Project Manager. Salvaged material may be handed over by the Contractor to the local authority on instruction from the Employer.

5.3 Dismantling & Removal of Existing Structures for Rehabilitation Sites**Description**

This item shall consist of the removal/ dismantling and satisfactory cleaning, stacking, storing or disposal, inside or outside the site of such portions of existing structures as provided in the Plans, Schedule of Quantities and Specifications or ordered by the Project Manager. This includes all items such as breaking and removal of masonry debris, concrete, R.C.C, brick work, plaster and other items as mentioned in schedule of quantity or as directed by the Project Manager.

Construction Requirement

Before commencement of removal/ dismantling work, the structure or parts thereof shall be properly earmarked and necessary arrangement for stabilization of the adjoining structures shall be ensured by means of adequate shoring, shuttering, propping and strutting. The dismantling work shall not commence until the arrangement of safety of the adjoining structure has been insured by the Contractor, inspected and approved by the Project Manager. The Contractor shall be solely responsible for any damage to the portion of structure which were not intended to be dismantled and make good the damages, if any, at his own cost. The Contractor shall comply with all safety regulations and shall furnish, erect and maintain suitable barricades and warning signs and take such other measures as necessary to prevent personal injury or property damage. All these barricades, warning signs shall comply with the by-laws, regulations and provisions of BNBC and shall be to the satisfaction of Employer, and Local Authorities concerned.

This item of work also includes cleaning and sorting out of the salvaged materials in a usable condition, transporting and storing neatly for use/disposal as directed by the Project Manager. The items of dismantling works of different structures in foundation also include all excavation, bailing out water by pumping, drainage, bracing, shoring, etc. as found necessary and their subsequent removal and satisfactory disposal of all materials obtained from such excavations and backfilling to the level of original ground where required. The Contractor shall keep adequate records of all dimensional measurements of the structures and all other information relating to them as revealed and obtained during their work and have such measurements and information duly endorsed by the Project Manager at site. The work shall not start unless full measurement is recorded by the Project Manager. In some special cases, however, the recording may be done after dismantling.

The salvaged materials before or after dismantling shall be immediately measured and recorded in presence of the Project Manager and shall be in the custody of the Contractor until instructed to be disposed of by the Project Manager. Any loss of any dismantled material shall be recovered from the Contractor's bill at the recovery rate.

5.4 Site office Facilities for the Project Manager and his Staff

Description

The Contractor shall provide and maintain temporary site office facilities during the construction period for the Employer and Consultant.

5.5 Earth Work in Excavation for Structure

Description

The item shall consist of setting out true lines to all foundations for structures, performing the excavations to the required levels and grades in any kind of soil encountered, removing the spoils and backfilling of original ground line as provided in these specification or as directed by the Project Manager.

Construction Requirements

The Contractor shall comply with all safety regulations and shall furnish, erect and maintain suitable barricades and warning signs and take such other measures as necessary to prevent personal injury or property damage.

5.5.1 Earth Filling

Description

The item shall consist of filling any place or area, to make up levels, according to these Specifications and Plans with specified earth materials.

Construction Requirements

Silty Sand or other approved materials, free from large lumps, organic or other extraneous materials, shall be used for fill. Materials from excavation on the sites may be used as ordinary fill if it is approved.

The fill materials shall be deposited and spread in successive uniform horizontal layers of about 150 mm thick and compacted by use of mechanical 1.5 ton “Vibro” compactor or other approved devices to a 98% standard dry density in road and pavement sub-base and 95% standard dry density for other area.

Tests shall have to be carried out at recognized laboratory to ascertain the nature of the fill material and the degree of compaction obtained for the filled material for which samples have to be taken and transported by the Contractor at his expense and as directed by the Project Manager.

5.5.2 Sand Filling

Description

The item shall consist of filling any place or area, to make up levels, according to these Specifications and Plans with specified and approved materials.

Construction Requirements:

Silty Sand or other approved materials, free from large lumps, organic or other extraneous materials, shall be used for filling Materials from excavation on the sites may be used as ordinary fill if it is approved.

Materials

Fineness modulus not less than 1.0 shall be clean and free from organic and other deleterious materials

The fill materials shall be deposited and spread in successive uniform horizontal layers of about 150mm thick and compacted by use of mechanical 1.5 ton "Vibro" compactor or other approved devices to a 98% standard dry density in road and pavement sub-base and 95% standard dry density for other area. In filling /back filling against a newly constructed structure precaution must be taken so that the structure is well matured to take the thrust of filling and while filling that against a wall, the filling is done from both sides simultaneously.

Tests shall have to be carried out at recognized laboratory to ascertain the nature of the fill material and the degree of compaction obtained for the filled material for which samples have to be taken and transported to the recognized laboratory by the Contractor at his expense and as directed by the Project Manager.

5.6 Brick Flat Soling (BFS)**Description**

The item shall consist of supplying and laying bricks on top of the earth or sand bed to form a sub-base.

Construction Requirements

Bricks shall comply with requirements of First Class bricks. The binding sand shall have a minimum Fineness Modulus of 1.0 and shall be clean, and free of any organic matters.

Bricks shall be laid flat in surface to surface contact with adjoining bricks and their joints shall be filled with sand. The sand shall be brushed in until the joints are filled. Flushing in of sand with water shall not be done unless permitted. Bricks shall not be laid on the floor or foundation bed until the floor or foundation bed is inspected and approved by the Project Manager.

In case of Multi-layer Soling, care shall be taken to stagger or "break" all joints in placing subsequent courses of soling. No brick shall be laid on loose earth or earth filling which are not compacted to the desired degree.

5.7 Lean Cement Concrete (CC) Works

The specification shall be the same as for RCC works excepting that:

- (i) No reinforcement shall be used;
- (ii) Proportion shall be as noted in Schedule of Items;
- (iii) 12 mm downgraded chips of Jhama bricks /Boulder shall be used as coarse aggregate as specified in Schedule of items;

- (iv) The curing shall be done for 7 days minimum;
- (v) Compaction of concrete may be done by wooden or steel tempers or rammers in lieu of vibrators.

In order to improve bond with masonry/concrete work coming above it, if required, the surface shall be roughened before it reaches initial set, by scouring with the help of a pointed tool.

5.8 Cement Concrete in Floor

Description

The work covered by this item shall consist of constructing in floor or elsewhere, 75mm or 38mm thick cement concrete with 1:3:6 mix of cement, sand of FM 1.2 and 12mm downgraded bricks or stone chips as specified in schedule of items.

Construction Requirements

Construction shall be carried out as per requirements of drawing.

5.9 Damp Proof Course

Description

The work covered by this item shall consist of constructing, on top of foundation walls or elsewhere 75mm/ 38 mm thick artificial stone with a 1:1.5:3 mix of cement, sand of FM 2.5 and 12 mm downgraded crushed stone chips and finishing with a coat of bitumen as per instruction of the Project Manager.

Construction Requirements

Damp-proof course shall extend the full width of the plinth walls unless otherwise required by the plans and shall be laid only after the levels of the plinth have been checked.

5.10 Reinforced Cement Concrete Work (RCC)

Description

This item shall consist of manufacturing concrete as provided in these Specifications and construction where required, and of the form, dimensions and design shown on the plans.

Construction Requirements

Concrete shall consist of a mixture of Portland cement, fine and coarse aggregate and water. The proportions in which the various ingredients shall be used in the concrete mix for various work, shall be designed in accordance with the specified strength and suitable workability.

Material shall conform to the requirements specified below and in the relevant sections Material Specifications.

Construction shall be according to these specifications. Contractor shall follow the following standards of American Society of Testing Materials along with the Building Code Requirements for Reinforced Concrete ACI 318-89 for Specification not covered in these Specifications. In case of differences between specifications contained in this book and those of ASTM or ACI, the specifications specified in this book shall stand.

Cement

"Specification for Ordinary Portland Cement" (Type-I)	- ASTM C150 or BS12 -
"Specification for Concrete Aggregates"	ASTM C 33
"Standard Method of Making and curing concrete Test Specimen in the field"	- ASTM C31-89
"Standard Method of Test for compressive strength of cylindrical concrete Specimens"	- ASTM C39-86
"Standard Method of Sampling Fresh Concrete"	- ASTM C172-90 -
"Standard method of Making & Curing concrete Test Specimens in the laboratory"	ASTM C192-90
"Standard method of obtaining and Testing Drilled Cores and Sawed beams of Concrete"	- ASTM C42-90
"Standard Specifications of Chemical admixtures in concrete"	- ASTM C494
Cement shall be Portland Cement Type-I, ASTM	- ASTM C150

Portland cement to be normally used shall conform to ASTM specification C-150 type-I or BS-12. It shall be free from any hardened lumps and any foreign material other than the manufacturing ingredients. Cement shall have a minimum 90% of particles by weight passing the 75 micron sieve. Cement shall have an initial setting time in excess of 30 minutes and final setting time not longer than 7 hours. The Project Manager reserves the right to reject any cement that fails to achieve specified concrete strength as per proportion of materials laid down in the schedule of items.

Only approved brand, grade or kind of cement shall be used in a given structure above the ground level specially, for face finished concrete, tiles works etc. except upon the written permission of the Project Manager of other used.

The Contractor shall be responsible for the proper storage of the cement at the job site. Cement shall be stored in an air tight waterproof shaded area having damp proof floor, waterproof walls and leak proof roof. The cement stacks shall be placed at a minimum distance of 300 mm from the walls. The damp proof floor shall be constructed by raising it minimum 300 mm above the ground. If the cement is damaged and becomes lumpy due to defective storage, it shall be removed from the job site within 24 hours of receipt of instructions from the Project Manager.

Cement may be measured by weight of in a standard bag to weigh 1 cwt or 112 pounds/50kg having a volume of 0.0354 cum or 1.25 cft. The Contractor shall maintain the record of deliveries of cement to the site and its use in the work.

Fine Aggregate (Sand)

Fine Aggregate shall consist of well-graded clean natural sand, free from injurious amount of organic impurities and deleterious substances and shall have a fineness modulus of not less than 2.50. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following requirements:

Sieve	Mass
	Percent passing
9.5 mm (3/8 in 4.75	100
mm (No.4) 1.18 mm	95 - 100
(No. 16) 0.300 mm (	45- 80 10
No. 50)	– 30
0.150 mm (No. 100)	2 -10

Coarse Aggregate

Coarse Aggregate shall consist of well-graded broken or crushed first class jhama bricks or boulder chips as specified on the structural drawings and/or BQ and shall be free from any adherent coatings.

Grading of Coarse Aggregates

Coarse aggregate shall be well graded, between the limits specified and the size or sizes designated shall conform to the requirements given in the following tables or otherwise specified or directed by the Project Manager.

Designated sizes	Percentage by weight passing US Standardsieves having square openings						
	38 mm	25 mm	20 mm	12 mm	10 mm	No.4	No.8
25 mm down graded	100	95-100	--	25-60	--	0-10	0-5
20 mm down graded	----	100	90-100	--	20-55	0-10	0-5
12 mm down graded		--	100	90-100	40-70	0-15	0-5

Delivery and Storage of Materials:

a. Cement

In transit and storage or stock-piled at site shall be protected from dampness or any damage by climatic conditions that would change its characteristics or usability. Cement at site shall be stored in dry weather proof godowns (or shed) built at the cost of the Contractor. Cement must not be stacked in more than 10 bag height. Sufficient space shall be provided for circulation and rotation of bags in order to minimize the length of storage of any of the bags. The floor of the godown shall consists of wooden planks resting on base prepared of dry bricks laid on edge. Batches of cement shall be used for the work in the order in which they are delivered to the site. A register shall be maintained by the Contractor listing date of delivery and quantity of each consignment for easy identification.

b. Aggregates

Aggregate shall be stock-piled at least 7 days prior to their anticipated use to permit the Project Manager to sample each stockpile to determine the acceptability of the material for the intended use.

Aggregates of different sizes or grades and from different sources of supply shall not be mixed. All aggregate shall be stored free from contact with earth and other deleterious matter.

Every precaution shall be taken during transport and stockpiling of coarse aggregate to prevent segregation.

Segregated aggregates shall not be used until they have been thoroughly remixed and the resultant pile is of uniform and acceptable grading at any point from which a representative sample is taken.

Composition of Mix

The strength requirement and workability shall govern the mix proportion for each class of concrete:

Proportion of concrete	28 day cylinder crushing strength (min.)	Place of Use	Aggregates		Min. Cements per m ³ (50 kg bag)
			Fine	Coarse	
(1:1.5:3)	21 MPa	In footing, water tank, column, slab, beam, stair lintel and all other RCC works like switch yard foundation	Sand FM 2.5	20 mm down graded stone chip	8.0 bags
(1:1.5:3:0)	20 MPa	In Damp Proof Coarse	Sand FM 1.2	12 mm down graded stone chip	8.0 bags
(1:2:4)	18 MPa	In all RCC works in Ancillary Structures	Sand FM 2.5 & 1.5	20 mm down graded picked jhama chip'	6 bags
(1:3:6)	15 MPa	In bellow foundation and Floor(C.C)	Sand FM 1.5	20 or 12 mm downgraded picked jhama chips	4.5 bags

Slump Slab, Beam, Columns etc. -50mm.

Trial mixes for every class of concrete with representative materials from site shall be prepared by the Contractor and carried to the laboratory in accordance with approved procedure. The nominal strength in these tests shall exceed the specified minimum strength by at least 20%. No concrete shall be placed in the permanent works until the relevant mix has been approved by the Project Manager.

Batching

The Contractor shall provide and maintain in good order suitable measuring equipment and devices required to determine and control accurately the relative amounts of various materials entering the mix. All measurements shall be by weight/volume and shall be accurate within a tolerance of 1 % for each batch. If the measurements are by volume then standard wooden boxes shall be used.

a. Cement

Unless an integral number of bags, as packed by the manufacturer is used, the Cement shall be weighed. A bag of cement weighing 50 kg net shall be considered as 0.035 m³

b. Aggregates

Different types and sizes of aggregates shall be batched separately by weight/volume.

c. Water

The amount of mixing water shall be weighed/measured, allowance being made for the quantity of the free water contained in the aggregates. Water cement ratio shall be decided for every class of concrete and according to the place of use. The water/Cement ratio shall not exceed 45% by weight for all type of concrete.

Sufficient acceptable materials shall be available at the batching site to ensure continuous placement necessary for structures. The moisture content of the accepted aggregate shall remain consistent to the extent that the resultant successive batches of concrete do not vary in consistency by more than 6 mm of slump. If the moisture content in the aggregate varies by more than the above tolerance, corrective measures shall be taken to bring the moisture to a constant and uniform quantity before any more concrete is placed.

Coarse aggregate shall be saturated with water at least 12 hours before use to prevent absorption of the mixing water.

MIXING OF CONCRETE

a) Machine Mixing:

Concrete shall be mixed in concrete mixer of approved type and appropriate capacity.

Each batch shall be thoroughly mixed for a period of not less than 2 minute after all materials including the water are in the drum and during this period the drum shall be in the mixing position and revolve at uniform rate of not less than 14 or more than 20 revolutions per minute. The cement and sand shall be thoroughly mixed in dry condition.

The batch shall be so charged into the mixer drum that some water shall enter in advance of the cement and aggregate. The entire content shall be removed from the drum before the succeeding batch is placed.

Concrete shall be mixed in quantities required for immediate use. Concrete shall not be used which has developed initial set or which is not in place within thirty (30) minutes after the water has been added. Re-tempering of partially hardened concrete by remixing with or without additional materials or water, or by other means shall not be permitted. The inside of the mixing drum shall be kept free of hardened concrete at all times.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed. Unless otherwise agreed by the Project Manager, the first batch of concrete through the mixer shall contain only two thirds of the normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

b) Hand Mixing:

Hand mixing shall not be permitted except for unimportant structural members and only at the discretion of the Project Manager. When hand mixing is permitted it shall be taken to ensure that the mixing is continued until the mass is uniform in colour and consistency. If hand mixing is permitted by the Project Manager, the Contractor shall use 10% extra cement for hand mixing for which no extra payment will be made.

Consistency of Concrete

The consistency of concrete shall be determined following evaluation of the placement conditions for each individual section of the work but in no case the slump shall exceed 62mm unless otherwise decided. Mix proportions and consistency shall produce a dense, well compacted concrete with a minimum tendency to segregate under placing conditions, free from sand streaks, honeycomb, air-pockets, exposed reinforcing steel and other forms of structural weakness or unsatisfactory appearance.

Transport and Placing

Concrete shall be so transported from the mixer and placed in the form that contamination, segregation or loss of the constituent materials does not occur. Before placing the concrete, all form work, space and the reinforcement contained in it shall be thoroughly cleaned of all extraneous matter. Care shall be taken to fill every part of the forms, to work the coarse aggregate back from the face so that sufficient mortar shall be flushed from the mass to form a smooth surface, and to force the concrete under and around reinforcing bars without displacing them.

The concrete shall be deposited in the forms in horizontal layers to a depth not exceeding 300 mm and each layer shall be properly vibrated before laying the next one.

The concrete shall not be dropped freely from a height exceeding 1.0 meter nor shall it be deposited in large quantities at any point. In columns of structures special tremie pipe may be used for drop more than 1.8 meters. Dragging of concrete inside the forms or distribution by vibrators or allowing it to flow by gravity to the ends of the forms shall not be permitted.

In sections where it is extremely difficult, to place concrete containing the larger sizes of the coarse aggregate, a modified mix, as approved by the Project Manager, may be used to ensure against honeycomb and separation of the coarse aggregate from the mortar. Concrete shall be deposited and compacted in its final position within 30 minutes of its discharge from the mixer and shall not be subjected to vibration between 2 and 24 hours after compaction. When in situ concrete has been in place for 4 hours no further concrete shall be placed against it for a further 20 hours.

Compaction

Concrete, during and immediately after placing, shall be thoroughly compacted by mechanical vibration. The vibration shall be internal unless otherwise authorized by the Project Manager.

Vibration shall be of a type and design approved by the Project Manager. It shall be capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.

The intensity of vibration shall be such as to visibly affect a mass of concrete of one inch slump over a radius of at least 450 mm.

The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. He also provided sufficient number of nozzles of different diameter to execute the work smoothly.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete.

Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to lie plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation. Vibrators shall not be used to transport concrete in the forms.

Concrete pouring schedules and construction joint sequences of different stages shall have to be approved well in advance by the Project Manager.

Construction and Expansion Joints

Expansion joints shall be constructed at the locations and to the dimensions shown on the plans. Position and detail of construction joints, not shown on the plans, shall be planned in advance and approved by the Project Manager. Placement of concrete shall be in a continuous operation between consecutive joints.

Where sections of the work are carried out in lifts, the line of the proposed joint on all exposed surfaces shall be made truly straight by tacking a temporary horizontal straight edge on the inside of the form with its lower edge on the line of the joint and then placing concrete 12 mm higher than this edge to allow for settlement. In case of water reservoir PVC water stopper shall be used in all construction joints with 250 mm overlapping at the water stopper joints.

In resuming the work, the old concrete surface shall be thoroughly cleaned of laitance and all loose material by stiff wire brush, roughened, if deemed necessary, and washed with clean water.

The surface then shall be coated with very thick cement slurry before fresh concrete is placed.

Water Reservoir/Tank

Admixture of Sika Plastocrete Super (Conforms to both IS 2645 and IS 9103) 0.2% by weight of cement or similar product of approved quality at manufacturer recommendation for heavy duty water tank are to be used in bases and walls of R.C.C. reservoirs/tank.

Special Casting process for Columns and R.C.C. Wall

Minimum of construction joints shall be allowed in beams, slab and column of the structures. No construction joint in columns from below floor to bottom of beam shall be allowed, column must be cast in a lift, to avoid any construction joint below lintel level. Special shuttering with opening at middle height shall be used for the facility of casting. The opening shall be closed after casting of concrete up to that level without disturbing the green concrete. The Contractor shall prepare shuttering details ahead of actual work and shop drawings are to be approved by the Project Manager. In any case the safety and stability of form work shall be the Contractor's responsibility. No construction joint shall be allowed between beam, web & roof slab of building. For wall & water reservoir no concrete shall be placed from a height of more than 1.0m and the shuttering of the wall shall not be more than 1.25m in height.

Control Tests for Concrete

a. Sampling:

The number, frequency and location of batches to be sampled shall be decided by the Project Manager. The method of sampling shall be according to ASTM C172.

b. Slump

This determination shall be made at the commencement of concreting, on the occasion of each change in mix proportions, and thereafter when requested by the Project Manager. The testing shall be in accordance with ASTM C- 143, current issue.

c. Compressive Strength

Test cylinders 150 mm in diameter and 300 mm high shall be made at the site of the work in sets of three (3) from each thirty (30) cubic meter of each class of concrete or fraction thereof or as directed by the Project Manager.

Casting and curing the concrete cylinders shall be in accordance with ASTM C-31, current issue. Testing of cylinders shall be done in accordance with ASTM C- 39, current issue; one cylinder at 7 days and 2 at 28-days. Cylinder at 7 days test shall not be less than 70% of the specified (design) strength.

If the Project Manager allows cubes to be tested instead of cylinders, the cube strength shall be at least 25.0 percent higher than the cylinder strength specified.

The Contractor shall arrange to transport the cylinders/cubes to the approved laboratory and arrange to have the test results forwarded (in duplicate) directly from the laboratory to the Project Manager or his appropriate site representative. The Contractor shall bear all expenses in connection with the preparation of test cylinders /cubes, i.e. provision of moulds, cost of concrete, labor and transportation charges to the approved laboratory, laboratory testing charges etc.

Formwork

Formwork may consist of steel sheets of minimum thickness of 14 BG or wooden planks of hard wood of approved variety having a minimum thickness of 45 mm with necessary battens, struts, stringers, beams, ties, etc. In case of wooden planks the same shall be new and shall not be used more than three times in contact with concrete.

All formworks, especially for fair face concreting, must be 12 BG steel sheet and should be dented, rust free by using of sanding disk etc. before every lift of casting.

All formwork shall be of sound materials constructed water-tight, true to line as per drawing and of such rigidity to prevent bulging or movement during the placement and curing of the concrete. Form work for bases and walls of water reservoir shall have chamfer of appropriate dimension as per drawing and direction. After hardening the concrete shall conform to the shape, dimensions and surface finish described in the Contract. The forms shall be simple in construction, easy for erection, maintenance and removal

Form lining shall be in largest practicable panel to minimize joints. Under usual conditions the

following minimum periods between concreting and the removal of formwork shall be observed:

Vertical sides	: 72 hours :
Soffits from under span of 6 meter or less	18 days
Soffits from under span of over 6 meters	: Min. 21 days and as directed by Project Manager.

Concrete exposed by the removal of formwork shall be left untouched pending inspection by the Project Manager. Cement mortar separators or block of appropriate sizes are to be used in all covering as per drawing or directed by Project Manager.

The drip course shall be constructed at the edge of roof slab etc. by means of an approved batten included in the form work before casting or after casting as desired by the Project Manager.

Surface Finish and Remedial Treatment of Surfaces

Unless otherwise provided on the plans, all reasonably true and even surfaces, which are of uniform colour and texture, and free from stone pockets, honeycomb, depressions or projections, shall be considered as acceptable surfaces.

Immediately after the removal of forms, all cavities produced by form ties and all other holes, broken corners or edges and other defects except air bubble holes, shall be cleaned and after having been kept saturated with water for a period of not less than two hours shall be completely filled, rammed and made good with a mortar of the same proportions as used in the concrete being finished.

The holes shall be completely filled by use of a pressure gun or hand rammed method as directed by Project Manager's representative.

Any remedial treatment to surfaces shall be agreed with the Project Manager following inspection immediately after removing the formwork and shall be carried out without delay. Any concrete, the surface of which has been treated before being inspected by the Project Manager, shall be liable to rejection.

Curing and Protection

Concrete shall be protected against harmful effects of weather for a period of not less than seven (7) days immediately following the placing of concrete.

All concrete surface shall be covered with two thicknesses of wet burlap which have been spot stitched, or wet jute felt or gunny bags as soon after placing of concrete as it can be done without marking the surface and kept thoroughly wet by continuous sprinkling of water for a period of not less than 21 days after the concrete has taken its final set.

In lieu of continuous sprinkling, plastic sheeting or plastic coated burlap may be used to prevent moisture loss. The concrete RCC shall be pre-moistened and the plastic sheeting shall be held securely in place so that positive moisture seal is provided to retain the curing moisture during the 21 days curing period. Form of perforated sheeting shall be repaired or replaced with acceptable material.

TRAINED SUPERVISOR

It is essential that the Contractor's supervisor who is in charge of the construction of all concrete work whether reinforced or not, shall be skilled in this class of work and shall superintend personally the whole construction and pay special attention to :

- a) The quality, testing, proportioning and mixing of the materials and particularly control of water cement ratio
- b) Laying of materials in place and thorough consolidation of the concrete to ensure solidity and freedom from voids.
- c) Position of reinforcements.

5.11 RCC with Water Proofing Admixture

Description

This item shall be done as described in item 2.12 except that for water proofing admixture of Sika Plastocrete Supper (IS: 2645, and IS 9103) in proportion of 0.2% by weight of cement' or "SUPER BARBARA 05" of MBI International AG, NITTOPROOF of FOSROK or equivalent, made in UK/Switzerland/Singapore/Saudi Arabia in proportion recommended by the manufacturer is to be used in the concrete of the basement mat & wall, underground water reservoir and where necessary.

Construction Requirement

This approved admixture shall be put to the concrete mixture machine along with the cement. Other procedures are same as in item 2.10 including formwork etc.

5.12 Reinforcing Steel in Concrete

Description

This item shall consist of furnishing and placing in concrete reinforcing steel (Deformed bar) of quality type size and quantity designated, all as required by these Specifications and as shown on the applicable structural drawings.

Construction Requirements

Reinforcing steel shall be deformed bars of 60 graded as specified on the structural drawings and shall meet the following requirements:

1. Quality of reinforcement steel, its properties including strength, elongation, bending, splicing, hooking, covering and all related events shall be in accordance with the requirements of ACI 318-89.
2. De-formed bars, when used shall meet the requirements of BS: 4461 or ASTM: A615 of high strength of 60 - grade.

It should be noted that steel made from scrap iron shall not be accepted for any type of work. All reinforcement bars shall be clean and free from loose scale, dirt, paint oil, grease or other foreign substance. Bars should be placed in position as drawing/design requirement and be cleaned with a stiff wire brash if required.

Bending of Reinforcement

All reinforcement bars shall be bent cold to pertinent dimensions using bending appliances and method approved by the Project Manager. All bars of slab and beam shall invariably have standard hooks at the end. All standard hooks shall meet the following requirements:

- a. A semicircular turn plus an extension of at least four bar diameters but not less than 62 mm at the free end of the bar.
- b. A 90 degree turn plus an extension of at least 12 bar diameters at the free end of the bar.
- c. For stirrup and tie anchorage only either a 90 degree or a 135 degree turn plus an extension of at least six bar diameters but not less than 62 mm at the free end of the bar.

The radii of bend measured on the inside of the bar for standard hooks shall not be less than the values given below:

<u>Bar size</u>	<u>Minimum radii</u>
10 mm, 12 mm, 16 mm	2.5 bar dia.
20 mm, 22 mm, 25 mm	3 bar dia.

Bends for stirrups and ties shall have radii on the inside of the bar not less than one bar diameter.

Placing of Reinforcement

Reinforcement shall be placed, supported and maintained in the position shown in the Drawing and shall be checked and approved by the Project Manager before placement of concrete begins. Unless otherwise permitted by the Project Manager, all intersecting bars shall be tied together with double layer of 22G black iron wire and the ends of wire shall be turned into the main body of the concrete. Clear cover must be maintained to the side of reinforcement as shown on the drawing by using concrete blocks or separators.

Splicing of Reinforcement

No splices shall be made in the reinforcement where not shown in the drawing. Wherever it is necessary to splice reinforcement at points other than those shown on the plans, Drawings showing the location of each splice shall be submitted to and approved by the Project Manager before the reinforcing steel is placed.

a. Splices in reinforcement in which critical design stress is tensile

Splices at points of maximum tensile stress shall be avoided where possible, such splices where used shall be lapped or otherwise fully developed. In any case the splice shall transfer the entire computed stress from bar to bar without exceeding three fourths of the permissible bond values for the concrete. The length of lap shall be 40 bar diameter excluding hook. However length of splices to be used for different bars shall be according to drawing or according to the direction of Project Manager.

b. Splices in reinforcement in which critical design stress is compressive

Where lapped splices are used it shall be minimum of 35 bar diameters excluding hook. Where longitudinal bars are offset at a splice the slope of the inclined portion of the bar

with the axis of the column shall not exceed 1 in 6 and the portions of the bar above and below the offset shall be parallel to the axis of the column. Adequate horizontal support at the offset shall be secured by additional stirrups, ties, etc. Offset bars shall be bent before they are placed in the forms.

Supports

Pre-cast concrete blocks or metal supports of adequate strength, of proper dimension and in sufficient number shall be used for supporting the bars in position. Blocks shall be of a shape acceptable to the Project Manager and designed so that they shall not overturn when concrete is stored. They shall be made of concrete with 10 mm maximum aggregate size from same materials and of the same mix proportions as that of the concrete in which they are to be used. They shall be cast and properly cured for at least seven days before use and shall have wire or other device cast in the block for the purpose of attaching them securely to the reinforcement. Where directed chairs made with 12mm bars shall be provided for keeping the negative reinforcement in place during concreting. These chairs when used shall provide proper cover as required and the numbers shall be as decided by the Project Manager.

Welding of Reinforcement

Reinforcement in structures shall not be welded except where permitted. All welding procedures shall be subject to the prior approval of the Project Managers in writing. In pile reinforcement welding may be necessary and shall be done in accordance to the drawing and with the approval of the Project Manager. Welding for connecting the damaged portion of the reinforcement shall be allowed on both sides of the Re-bar and shall be 50 mm of welding length on both sides and on ends.

If welded connections are made on intermediate grade reinforcing steel, to hold bars in position, low hydrogen electrodes shall be used.

Concrete protection for Reinforcement

Unless otherwise shown on the plans, the covering of reinforcement for different types of members shall be as follows:

<u>Column, Footing/Mat & Pile Cap</u> All sides, below FGL		75 mm
<u>Column:</u> All sides, above FGL		50 mm
<u>Grade Beam:</u> All faces		60 mm
<u>Other beams in Structures:</u> Side, Top and Bottom		50 mm

<u>Slab, lintel and staircase:</u>		
Bottom		25 mm
Top		20 mm

Protective Coating

All exposed reinforcing steel at construction joints shall be protected with a brush coat of neat cement, mixed to a consistency of thick paint, within one week after the placing of the initial concrete, unless it is definitely known that the steel shall be embedded within 60 days. This coating shall be entirely removed, by lightly tapping with a hammer or other tool, more than one week previous to the placing of the final pour. The Contractor shall notify the Project Manager or his authorized representative when the steel has been placed in position for pouring concrete and no concrete shall be placed until the Project Manager has inspected the steel and given his approval in writing.

5.13 Brick Work

5.13.1 250mm BRICK WORK AND ABOVE

Description

This item shall consist of constructing brick masonry work in **1:5** cement mortar in such thickness and at such heights as required by the plans.

Construction Requirement

All materials shall meet the requirement of the relevant sections of Material Specifications.

- a. **Bricks** shall be 1st class well burnt bricks of uniform colour, shape, size with sharp corners bricks unless otherwise specified.
 - b. **Cement** shall be Portland cement Type-I ASTM C- 150 or BS - 12
 - c. **Sand** shall be clean well graded natural sand having a minimum FM of 1.5. d.
- Water** shall be same as required for concrete.

Mortar

Mortar of brickwork unless otherwise required shall consists of 1 part of cement and 5 parts of sand.

Cement and sand shall be mixed dry in the specified proportions until the colour of the mixture is uniform. Water shall then be added sparingly, only the minimum necessary being used to produce a workable mixture of normal consistency, The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Project Manager.

The mixing shall be done on a clean hard platform with watertight joints to avoid leakage. The mixture should be covered with polythene sheet or other means so that dust or other foreign materials cannot be deposited. At the close of each day's work, the mixing trough and the pans shall be thoroughly cleaned and washed.

Mortar shall be mixed in quantities required for immediate use within 30 minutes of mixing.

Mortar, which has taken its initial set, shall, on no account be used on the work, nor shall it be remixed with or without additional materials or re tempered by other means.

Workmanship

No bricks shall be used until they have been thoroughly soaked in clear water for at least eight hours. Soaking shall be discontinued one hour before use. Care shall be taken that the bricks are clean and free from lime or dirt of any kind. If necessary, bricks shall be scrubbed clean.

Brickwork shall be built in plumb and shall be carried up regularly throughout the entire length of the structure. Unless otherwise specified, bricks shall be laid in English Bond unless otherwise specified each brick being set with mortar in bed and vertical joints. All bricks shall be whole except where necessary for closers and where expressly authorized. All horizontal joints shall be parallel and level. Vertical joints in alternate courses shall come directly over one another. Joint thickness should be uniform and shall be 6 mm for pointing brick work and shall in no case exceed 10 mm for other brick works. Exposed joints shall be raked and flush-pointed unless otherwise specified and the face of the work shall be kept clean as work proceeds. The height of day's work shall be limited to 1.25 meter unless otherwise permitted. In exposed situations the day's work shall be protected against harmful effect of weather during and for a period immediately following construction until the mortar has sufficiently hardened. All brickwork shall be thoroughly cured for a period of at least 7 days. Fixture in masonry such as anchors, clamps, brackets, pipes, etc. shall be built-in during construction at no additional cost to the Contract.

5.13.2 125 mm THICK BRICK WORK

The work covered by this item shall consists in constructing 125 mm thick wall with 1st class bricks in 1:4 cement mortar at any heights as required by the plans.

Construction Requirement and Materials

Materials and method of construction shall be as stated in item 2.13.1 except that the mortar shall consist of 1 part of cement and 4 parts of sand.

5.14 Patent Stone Flooring

Description

The item shall consist of constructing 25 mm /38mm thick concrete with 12 mm downgraded picked "Jhama" brick chips, sand and cement in specified panels of floor slab and elsewhere in accordance with these Specifications, Use approximately 25 kg of cement per 10 m² for neat cement finish and finish with steel trowel up to the satisfaction of Project Manager or as directed.

Construction Requirements

Materials and construction shall be in accordance with the requirements of item 2.10. The flooring shall be laid preferably not later than 24 hours after the floor slab is poured. When flooring is to be laid on an older concrete slab, the base surface shall be thoroughly cleaned of all loose materials by stiff wire brush, roughened if seemed necessary and washed and soaked with clean water. Surplus water shall be removed and a dense cement grouting is applied to the surface before flooring is placed.

The floor shall be divided into panels of specified sizes, which shall not be more than 16 sq. m. by

means of wooden battens. The top of the battens shall be at the level of the finished surface.

The mixture shall be spread evenly between the battens in alternate panels and shall be uniformly consolidated and leveled by a strike-off. When the moisture has disappeared from the surface, the surface shall be steel trowelled under firm pressure to produce a dense uniform smooth surface free from trowel marks.

The dividing battens shall be removed carefully after 16 hrs and the remaining panels shall be completed in the aforesaid manner. Joints would be marked with thin ropes to allow cracks, if any, to form along straight line and providing neat appearance.

The work shall be cured and protected from weather for at least 10 days immediately following the laying.

5.15 Ceramic Tiles

5.15.1 Glazed Ceramic Tiles

Description

The work covered under this item shall consist of supplying and fixing glazed ceramic tiles on walls and where necessary on a 1:3 cement mortar in accordance with the applicable plans, schedules and these specifications.

Construction Requirements

Glazed ceramic tiles unless otherwise specified, shall be standard Grade 200mm x 300mm x 6mm and 250mm x 400mm x 6mm white interior wall tiles free from war page, blemishes and dimensional defects and conforming to the standards of Federal specification SS-T-308b.

Mortar for installation shall consist of 1 part cement to 3 parts sand (FM 1.5).

Grout for tile joints shall be made of white cement coloured as and where specified with inert pigments.

Preparation of wall surface and application of mortar bed shall comply with the provisions of item 2.16.1 & 2.16.2. If the surface needs leveling a scratch coat of plaster shall be applied, leveled and scratched for key and allowed to dry for 12 hours before installing tiles. The setting mortar shall be applied evenly and a neat-cement paste to a thickness of about 1.5mm shall be trowled to the back of tile and the tile set on firmly tapped into place to ensure full contact. The joints shall be in specified pattern and shall not exceed 1.5 mm in width.

The mortar bed shall be minimum 6mm thick and shall be cut through horizontally and vertically every 400 mm to 600 mm. The tiles shall be soaked in water for at least 6 hours before setting. Installation shall be controlled by strings, pegs, spacers, levels or other suitable methods to ensure correct layout and uniform leveled joints. The joints shall be grouted, cleaned and damp-cured for at least 3 days.

5.15.2 Non Slip Tiles Work

The Non slip tile shall be smooth, water proof, dust pressed with square edges (Bangladeshi) and size of the tiles shall be between 200mm x 300mm or 250mm x 250mm or 300 mm x 300 mm. No

border edging or rounding pieces shall be used. Length of each size of floor/wall shall be filled by the tiles completely. The cut sizes if used at the ends shall be equal in size and as closed to full size as possible by making either the edge or the centre of tile to coincide with the vertical centre line of floor/wall. The wall/floor on which the tile shall be applied shall be kept moistened for 2 hours. The bedding mortar in 1:2 using medium sand (FM 1.5) shall be applied. The joints in tiles shall be minimum 5 mm wide, kept clean for pointing and to be filled flush with pointing material with white or coloured cement mortar unless otherwise specified. Measurement shall be given for the actual area covered by the tiles. No measurement of the under bed shall be given.

5.16 Plaster Work

5.16.1 Plaster on Brick Masonry

Description

This item shall consist of providing 12 mm to 20 mm thick (1:4)/ (1:6) on walls, and where necessary in accordance with these Specifications & direction of Project Manager.

Construction Requirements

Materials shall meet requirements specified below and in the relevant section of Material Specifications.

- a. **Cement** shall be Ordinary Portland cement Type-I ASTM C- 150 or BS-12
- b. **Sand** shall be clean well-graded natural sand having a fineness modulus of 1.50. Sand shall be washed if necessary.
- c. **Water** shall be potable and clean and contain no salt or organic materials.
- d. **Admixture** shall be mixed with the cement mortar of approved quantity where item in BOQ is specifically mentioned.

Cement and sand shall be mixed dry in the specified proportion until the mixture is uniform in colour. Only enough water shall be added to provide plasticity. Mortar shall be mixed only in quantities for immediate use. Mortar which has taken initial set shall not be used on the work with or without addition of fresh material.

Before application of plaster, the joints in brick walls shall be adequately raked out where necessary and smooth concrete surfaces shall be roughened to provide key. The surfaces shall be scrubbed clean of loose materials and soaked with water and kept damped for 24 hours in case of brick masonry.

Plaster which consists of two coats, under and finish, when applied over brick masonry, the "under and finish coats shall be applied with an interval to permit the undercoat to set. Water proofing admixture of specified quantity shall be mixed with cement mortar as per manufacturer's instruction.

Plaster shall be kept moist by watering and protected from weather for at least 10 days immediately following completion.

If any cracks appear in the plaster or any part sounds hollow when tapped or is found to be soft or

otherwise defective after the plaster has dried, it shall be considered as defect and the defect shall be made good by cutting out and re-plastering at the Contractor's own cost.

5.16.2 Plaster on R.C.C Surfaces

Description

This item shall consist of providing 6 mm to 12 mm thick 1: 4 cement-sand plasters on all RCC members in accordance with this Specification.

Construction Requirement

Plaster shall consist of 1 part cement and 4 parts sand and have thickness of 6 mm and shall be applied in a single coat, where plaster on concrete surface is required 12 mm thick, it shall consist of two coats, under and finish. The under coat shall consist of a grout application and shall have minimum thickness of 6 mm and shall be leveled with straight edge and scratched for key. The finish coat shall be trowelled over with care and leveled with straight edge to obtain a flat smooth surface. The under and finish coats shall be applied with an interval to permit the under coat to set. All edges and corners unless otherwise shown on the plans, shall be rounded or chamfered as directed by the Project Manager. All moldings shall be neat, clean and true to template.

5.16.3 Plaster with Water Proofing Admixtures

Description

This item consists of providing 20 mm thick 1:4 cement mortar plaster with water proofing admixture of "Sika Plastorate Super" 0.2% by weight of cement or any other admixture of internationally reputed manufacturer in the proportion recommended by them shall be used as per manufacturer's instruction. This plaster shall be used on RCC surface or Brick wall or as directed by Project Manager.

Construction Requirement: Plaster shall consist of 1 part of Portland cement and 4 parts of sand with recommended quantity of approved water proofing admixture. However the whole procedure of this works shall be subject to the approval of the Project Manager.

5.17 Neat-Cement (Skirting/Dado)

Description

This item shall consist of providing 12mm thick neat cement with black/red oxide finished **(1:2)** cement-sand Skirting/Dado on a **(1:4)** cement-sand mortar plaster of 12 mm thick underbid on walls or where necessary in accordance with these specifications.

Construction Requirements

Materials shall meet requirement as stated in item in 2.16.1

Wall plaster, if any, shall be removed along the floor to the required height and the surface shall be thoroughly scrubbed and wetted before applying the underbid. The second undercoat shall have a nominal thickness of 6 mm and the total built-up thickness shall be same as that of the plaster on the wall. A 3 mm deep and 3 mm wide groove shall be formed where skirting/Dado meets wall plaster.

The skirting/Dado shall be installed flush with the finished wall surface. The intersection with the floor shall be a right angle and the top of the skirting/Dado shall be straight and sharp.

The underbid shall be laid as uniformly as possible and allowed to become firm before scratching for key and subsequently allowed to become thoroughly dry before applying the second undercoat. A neat cement paste 3 mm thick shall be spread evenly over the second coat and shall be steel trowelled under firm pressure to produce a dense uniform smooth surface free from trowel marks.

The work shall be cured and protected from weather for at least 10 days immediately following the installation.

5.18 Making Groove on Wall Surface

Description

The work covered by this item shall consists of making groove of 38 mm wide & 25 mm deep and to be provided on all types of wall surface as per drawing and direction of the Project Manager. The *faces* of the groove must be straight and well finished.

Construction Requirement

Before making groove wall shall be chiseled to attain the required depth of the groove. Care shall be taken for chiseling. In case of any damage the Contractor shall make good to the damage at his own cost.

5.18.1 Making Groove in RCC Casting (On Railings, Drop Walls & RCC Walls)

Description

Fair faced concrete of drop wall, railing and RCC wall shall have 20mm deep grooves as shown. All horizontal grooves shall be 40mm wide in the front and 30mm wide at the back and all vertical grooves shall be 25mm wide in the front and 20mm wide at the back.

Continuous horizontal grooves shall run between the parapet and the slab and also between the slab and the drop wall. Vertical grooves shall be 2.20m apart, positioned along the column axes and additionally two numbers in each bay except when otherwise shown. For R.C.C works in lift walls and staircase walls, the grooves shall be positioned as shown in the drawing. This is to be done by using approved hard wood plank made plain as per sizes to be fixed on the shuttering before casting of fair faced concrete. This wedge shaped timber shall be used for one time only and shall have to be changed/ replaced at the time of changing of plywood during shuttering work of fair faced concrete. This timber must be straight and free from any defect. REEBOL release agent or any other approved type is to be used before every casting.

5.19 Painting Works

5.19.1 Distempering

Description

The item shall consist of applying 2 coat of distemper of approved color over a coat of priming on plastered wall or ceiling surfaces where necessary in accordance with this specification.

Construction Requirements

Distemper shall be water bound distemper of Bangladeshi made (SPD of BERZER) of approved colour, shade and supplied in original sealed container. Priming consist of chalk wash with glue. The surface to be distempered shall be dry, well cleaned and free from efflorescence, dirt and stain of grease. The surface shall be given a thorough rub down to remove all loose materials and all cracks and surface irregularities shall be repaired with patching plaster and filler to obtain a smooth and even surface. The mixing of distemper shall be carried out in accordance with the instruction issued by the manufacturer of the particular brand of distemper that is to be used. Before starting work distemper shall be mixed in such way that one room can be finished with the same mix. Distemper is to be applied quickly. The brush to be dipped and stroked cross wise on the surface. No patchy overlaps shall be tolerated under any circumstances. Distemper shall only be applied with proper distemper brushes as supplied or recommended by the manufacturer. A sample area must be prepared first and got inspected and approved by the Project Manager before the full scale work commences. The distempers shall be used till such time as it gives a uniform texture.

5.19.2 White Wash

Description

The work covered by this item shall consist of applying minimum 3 coats of white wash with lime on plastered or un-plastered surfaces in accordance with these Specifications.

Constructional Requirements

Lime shall be slaked lime. The wash shall be prepared by mixing and stirring lime and water in such quantities as shall produce a mixture of the consistency of thin cream. When sufficiently mixed, the mixture shall be strained through a clean coarse cloth. Gum Arabic in proportion of 1 lb of gum to 15 lb. of lime shall be dissolved along with approved quantity of blue & zinc oxide in the strained wash.

The surface to be white washed shall be thoroughly cleaned of all foreign matter by the use of stiff wire brush, sand papering or other approved means. White wash shall be applied in minimum 3 coats alternately laid on vertically and horizontally. Each coat shall be perfectly dry before the succeeding one is laid over it. The wash shall be laid on with good hair brush & not with brush made of jute. The wash shall be laid in such a way that the whole surface should give a uniform texture.

5.19.3 Water Repellent Coating

Description

The item shall consist of applying 2 coats of clear silicone water repellent on exposed brick or concrete surfaces and cement plaster on wall, ceiling and elsewhere in accordance with these Specifications.

Materials

Silicone water repellent shall consist of sodium silicate or other alkaline silicates based clear approved product supplied in original sealed containers bearing the manufacturer's trademark.

Application Method

The application of water repellent coat shall strictly comply with the manufacturer's instructions. The application shall preferably be carried out after a period of dry weather and before applications; the surface shall be thoroughly clean and dry. A heavy coat shall be applied evenly direct from the container by flooding the surface with a wide brush so that at least 6mm penetration is achieved.

A second coat, applied as above, shall follow after 24 hours subjected dry & clean weather.

5.19.4 Enamel Paint

Description

The work covered under this item shall consist of applying 2 (two) coat of synthetic enamel paint of approved colour over a coat of priming on plaster wall or ceiling surface where necessary in accordance with these specification.

Construction Requirement

The plaster surface shall be painted with two coats or more of synthetic enamel ready mixed paint of best quality and approved color. *Before* application the surface shall be given a through rub down to remove all loose materials and all cracks and surface irregularities shall be repaired with patching plaster and filler to obtain a smooth and even surface. The paint shall be applied on appropriate primer after the surface has been finished with filler/putty, etc.

Before applying the paint on plastered surface the surfaces must be thoroughly smooth and cleaned from grease dirt and other foreign materials by a use of stiff wire brush, sand papering or other approved means. Painting shall not be carried out in damp weather. No patchy overlap shall be tolerated under any circumstances.

The enamel paint should Robialac (Berger) or equivalent and must be approved by the Project Manager.

Manufacturer's instructions for application for paint must be followed. The colour of the paint should be according to the direction of the Project Manager.

A sample area must be prepared first and got inspected and approved by the Project Manager before the full scale work commences

5.19.5 French Polishing to Wooden Surface

Description

The work covered by this item shall consist of providing French polishing work to wooden surface as per direction of the Project Manager.

Construction Requirement

French polishing to door frame and shutters three coats over a coat of priming including cleaning finishing and polishing with sand paper etc. all complete in all floor.

5.19.6 Plastic Paint

Description

The work covered under this item shall consist of applying 2 (two) coat of plastic paint of approved color over a coat of priming on plastered wall or ceiling surface where necessary in accordance with these specifications. The painted surface shall be easily washable by soft soap and water.

Materials

The plastic paint should be Robialac (Berger) or equivalent and must be approved by the Project Manager. The priming consists of appropriate type as specified for the paint by the manufacturer, and shall be applied accordingly.

Application Method

The surface to be plastic painted shall be dry, well cleaned and free from efflorescence dirt and stain of grease. The surface shall be given a through rub down to remove all loose materials and all cracks and surface irregularities shall be repaired with patching plaster and filler to obtain a smooth and even surface. The mixing of plastic paint shall be carried out in accordance with the instruction issued by the manufacturer of the particular brand of plastic paint that is to be used. Before starting work plastic paint shall be mixed in such way that one room can be finished with same mix. Plastic paint is to be applied with proper brushes as supplied or recommended by the manufacturer. A sample area must be prepared first and get inspected and approved by the Project Manager before the full scale work commences, The paint work shall not be considered as complete till a surface of perfect uniformity in color, shade and texture is achieved.

5.20 Timber Works

Descriptions

The item shall consist of supplying and fixing timber for doors, windows fitted with hardware and finished in accordance with the applicable plans, schedules and these Specifications.

Construction Requirements for Timber Doors

Timber for shutters, trims and frames shall be Silkorai/Teak/Chapalish. Grounds, studs and blocking shall be in sound Jam or other approved wood. All timber shall be free from sap, shakes, large or loose knots and defects affecting the appearance, strength and durability of construction and shall be well seasoned, dried to moisture content of 6% by weight and treated with non-swelling, non-staining water repellent paintable wood preservative.

Glue shall be waterproof approved product consisting of synthetic resin (phenolic, amino plastic or polyvinyl acetate) emulsion adhesives for wood or any other approved materials conforming BS-1204.

Knotting shall consist of a uniform dispersion of 25% flake shellac in 75% methylated spirit or other approved natural or synthetic resin in a suitable solvent and conform to BS-I336.

Stopping shall be made from white or red lead and sufficient linseed oil to produce a stiff paste and conform to BS-544.

Hardware shall be of approved material, finish, type and make and shall be complete with necessary screws, trims and all other accessories required for proper installation. All screws and accessories shall be of suitable size and type and shall match with the pigment as to material and finish.

Joinery workmanship shall be of the highest quality. All joints shall be well made, cleanly matched and tight. Verticals shall be plumb. Joints shall be put together with waterproof glue and if necessary further secured with finishing nails of softwood or with screws of hardwood.

Surface shall be finished smooth free from disfiguring defaces such as raised grain, stain, evidence of poor and uneven planning and sanding, tool marks, gouges and scratch.

All edges of woodwork shall be carefully trimmed and the arises eased by rounding to a radius 1.0mm.

Door frames in masonry walls shall be installed only after the walls are in place and have been cured.

Styles and rails shall be accurately cut and glued together with close fitting mortise and tenon joints which shall be further pinned with corrosion resisting metal pins of diameter not less than 5 mm or with hard wood pins of diameter not less than 7 mm. The joints shall be such as to ensure complete rigidity of framing throughout.

Panels shall be tongued-and-grooved unless otherwise shown on the plans, Wide flat surfaces shall be made of several narrow strips glued, dowelled, splined or dovetailed together as required.

All faces of frame buried or hidden in masonry shall be painted with 2 coats of tar paint before erection. The frames shall be installed plumb and fixed to brick masonry with flat iron hold fasts (225×37×6) mm tongued and turned at the ends and to concrete with No. 12- 90 mm long screws with suitable expansion-shields or fiber-lugs. The hold fasts and fixing screws shall be spaced not over 1 meter apart. The screw heads shall be countersunk at least 12 mm below the surface and plugged.

Butt hinges shall be set flush. All hardware shall be installed carefully in correct position strict conformity with the manufacturer's instructions. All hardware, fitting must have previous approval of the Project Manager before using into work.

Application of surface finishes shall conform to British Standard Code of practice CP-231.

After erection and before any finish is applied, all woodwork shall be hand-sanded using a succession of grit sizes each removing in turn all the coarser grooves created by the preceding grit. Knots and resinous streaks shall be treated with 2-3 coats of knotting applied evenly and thinly. Nail holes, cracks and cavities shall be filled in with stopping pressed well home with a stopping knife. Large holes or knots shall be plugged in with a mixture of red lead and enamel glue in equal quantities laid hot. Knotting and stopping shall extend slightly beyond the resinous area or cavity on to the adjacent surface.

The final preparation shall be by rubbing down with fine abrasive paper and dusting off with air jet. The sanding shall always follow the line of grain. No cross -grain sanding marks shall be admissible for any finish system on veneered or solid wood members. All wood surfaces shall be kept free of dust, dirt adhesives or other substances which would interfere with normal finishing procedure. Painting shall be done as per specification of respective item. If varnishing is required

the following specification shall be followed.

Oiling shall be done with linseed oil, either raw or boiled according to whether a flat or glazed surface is required. Unless otherwise specified a mixture of raw and boiled oil shall be used. The oil shall be rubbed into the wood till the surface is dry. The oil shall be applied sparingly and excess removed to avoid a sticky surface.

Lacquer varnish shall consist of a colourless finish of shellac diluted in alcohol. A wash coat of sealer consisting of $\frac{1}{4}$ Kg cut of shellac shall be applied first and when dry sanded lightly.

For internal works, 2 coats of lacquer consisting of 1 Kg cut of shellac shall be applied from a well charged clean brush which shall be worked on the surface no longer than is necessary to ensure even spreading. For external works 4 coats shall be applied. Each coat of varnish shall be lightly rubbed down with fine steel wool or abrasive paper and dusted before applying the next.

5.20.1 Single Leaf Flush Door

Description

The work covered under this item shall consist of supplying and fitting, fixing single leaf flush door in accordance with applicable plan or same as existing door.

Construction Requirement of single leaf flush door

The single leaf flush door of approved size of best quality Bangladesh made (as approved) shall be BFIDC or equivalent standard.

5.21 Metal Works

Description

The item shall consist of providing installing and finishing in place steel doors & windows with grill, rolling shutters, collapsible gate, ventilators, gates, boundary grill, hand rails or any other items, including frames made of plain steel structural shapes, plates, angles, pipes rods, wire mesh, steel sheet etc. where necessary in accordance with the applicable plans, schedule and these Specifications.

Construction Requirements

Mild steel pipe shall be of specified size conforming to the requirements of ASTM A53.

Structural steel shall conform to the requirement of ASTM A-36 and shall include plain structural shapes and plates cut to length or fabricated.

Glazing shall be provided with 3mm thick transparent acrylic panes (sheet).

All components of every item of work shall be accurately cut, formed, cast, fitted, welded and finished true to form and dimensions as indicated on the plans and drawings. Unless otherwise specified all welding shall be fillet welding.

All steel surfaces shall receive 2 coats of hard-gloss paint of approved colour over a coat of approved anti-corrosive primer unless otherwise specified. Prior to painting, the surface shall be cleaned of mill scale, rust, oil grease and dirt. Surface not painted to the Project Manager's satisfaction shall be repainted at Contractor's own cost.

5.21.1 M.S. Grill

Description

The steel frame shall be made of mild steel as per drawing and design. This is to be fitted at any places as per drawing and direction of the Project Manager.

Construction Requirement

The mild steel shall conform of the requirements of ASTM A-53. The structural steel shall conform of the requirement of ASTM A-36. These flat and angle M.S. sections are to be cut to sizes, fabricated, welded (continuous) and to the shape and sizes of the frame as per drawing. This frame shall have two coats of synthetic enamel paint over a coat of approved anticorrosive primer. The enamel paint should be of approved colour. Each frame must have min. 8 nos. of clamps on 3 sides of the frame.

A frame should be prepared and deposited with the Project Manager for his approval. Only after approval the manufacturing should start.

5.21.2 Switchyard Structures

The switchyard structures shall be a cost effective combination of spun concrete poles (SPC) and galvanized members. The concrete poles shall be design/manufactured in accordance with the standard REB specifications.

Method of Construction

A truss is a formed structure composed generally of straight members so arranged and fastened together at their ends. The stresses in the members, due to the forces at the joints are either tension or compression. Most of the trusses in practice are composed of a number of triangles formed together.

The plane truss consists of a number of bars jointed together such that they lie in one plane & form a frame-work which is suitable against any type of loading acting in the same plane.

Mild steel work in trusses should be done with mild steel sections of different sizes as per design and drawings. These sections are to be fitted and fixed in positions carefully as per design and drawing with gusset plates, nuts & bolts, rivets or by welding. Then after cleaning the surface adequately two coats of anticorrosive paint over a prime coat of red oxide or red lead shall be applied with appropriate applicator. To determine the number of rivets, must be known the design load, thickness of gusset plate and angles, the sizes of rivets and allowable unit stresses.

5.22 Aluminum Doors, Windows etc.

Description

The works under this item shall consists of supplying and fixing of aluminum products of various types such as doors, windows, curtain walls, curtain rails, cladding/ flushing of sills, etc. fitted with necessary hardware and finished in accordance with applicable drawings and specification.

Construction Requirements

a) Materials and Products

Doors, windows, curtain walls etc. shall be of approved standard conforming to the U.S. Architectural Aluminum Manufacturers Association (AAMA) or BT A specifications. The frames and sash members shall be of extruded shape made of 6063 T5 high quality aluminum alloy having a minimum section thickness of 2mm unless otherwise shown on the drawings or indicated in the schedule of items and shall conform to AAMA or BT A standard.

b) Fasteners, Hardware and anchors

Fasteners, hardware and anchors shall be of aluminum or non-magnetic, non-corrosive material compatible with aluminum, All windows shall be provided with non-jamming latches of rocker type designed to be locked from inside. Window locks shall be flush type as manufactured by the Adams Rite Manufacturing Company of Glendale, California or approved equivalent. The doors shall be provided with cylindrical locks and suitable built-in non jumping latches and bolts.

Security locks shall be pin type mortise lock, 6 or 7 pins and adaptable to Master, Grand master and Great Grand Master keys. Sliding windows and doors shall be fitted with adjustable sealed bearing sheaves of durable hydrated nylon or approved equivalent. Closers Push/pull and kick plates shall have to match with the frames. Any other hard wares to be incorporated in the work shall also match with the frame. Assembly and installation screws shall be of stainless steel. Doors, Windows, curtain walls etc. shall be installed with teflon injected expanding bolts, Sills shall contain adequate provisions for drainage. Head, sills and jamb members shall be of one piece construction. Aluminum to aluminum contact between hardware parts or moving members shall not be permitted. Such contacts shall be properly insulated.

c) Glass Pane

Glass shall be 6mm thick tinted dark bronze float glass panes (Japan, Bangladesh or Equivalent). Or as per drawing, schedule of item and direction of the Project Manager.

d) Glazing Beads

Glazing beads shall be aluminum shape-in interchangeable type.

e) Glazing Strips

Glazing strips or channels shall be of formed neoprene of acceptable quality.

f) Weather Stripping

Weather stripping shall be of neoprene or silicon treated woven wood or approved equal.

g) Joints

Joints shall be mechanically done square (telescopic) joints. No mitred Joints shall be accepted. No forced fitting shall be accepted. All units shall be fabricated at the factory to accurate dimensions.

It shall be rigid and designed to permit complete weather stripping. In principle, the parts should be put together by self-tapping screws.

h) Surface Finish

All exposed surfaces of aluminum members shall be factory finish and of substantially uniform appearance conforming to "Architectural" standard.

All exposed surfaces shall be given a natural Anodic Oxide hardcoat coating of 15 micron in thickness and a density of 25mg. per square inch and a uniform color tone conforming to the U.S. Aluminum Association or equivalent standard. The color spectrum shall be natural silver/approved shade of bronze or all exposed surfaces of the Aluminum frames shall be electrostatically painted with VV resistance hard resin powder with minimum coating thickness of 40 micron of approved color shade. Finish of hardware shall match closely with the door/window/curtain wall finish.

i) Accessories

Accessories necessary for proper fixing and preparation such as anchors, clips, fins, sub-frames, metal sills, mullion, covers, casing, other trim, cleaning anchors, glazing beads, weathering and glazing strips, hardware and mechanical operators shall be supplied ready to set in place with the door, window, curtain wall units.

Steel or wood sub frames shall be painted with Zinc-chromatic primer in case of steel and' with wood preservative in case of wood. Steel anchor shall be properly insulated from aluminum frame.

j) Sealant

Sealant shall be one part elastic compound of "Architectural" grade caulk and shall be in matching color or as approved by the Project Manager.

k) Shop Drawings

The Contractor shall prepare detailed design of all work involved in line with the Consultants design and prepare Shop Drawings for the total work and submit to the Project Manager for approval before factory fabrication. All exterior doors, windows and curtain walls shall be designed to withstand a wind pressure of 30lb/sft.

l) Installation

All units shall be assembled at site under proper conditions, erected, fixed and glazed in place in strict conformity with manufacturer's instruction. All cut-out operations for hardware preparation shall be made accurately and reinforced as required.

All doors, windows, curtain walls etc. shall be set plumb, square, level and in exact alignment with surrounding works and shall be securely anchored ready for operation. All joints between the masonry openings and frames shall be caulked and sealed after installation of the frames. All installation works shall be done and finished in such a way as to ensure a free and smooth operation.

Abrasion or other injury to finished surfaces shall be carefully avoided. Cleaning should be accomplished with plain water or a petroleum type cleaning agent or with the manufacturer's recommended cleaning reagent. No corrosive reagent shall be used.

5.23 Water Proofing Polythene Sheet

Description

The work covered under this item shall consist of supplying and laying in place polythene sheets over brick flat soling in floor of buildings and where needed in accordance with the applicable Plans, Schedules and Specification.

Construction Requirement

The sheets shall be laid within the building covering the entire inside floor area. Before laying the sheets the brick surface shall be cleaned with a duster to give the surface a free of extraneous particles. The sheets shall be free of damage, tear or other imperfection and shall be laid such that there is a minimum of 225 mm overlap between, adjacent strips. The second layer shall be laid over the first in the same direction but with a stagger of half the strip width.

5.24 Lime Terracing on Roof

Description

The item shall consist of constructing a layer of lime concrete 2:2:7 on roof slabs in accordance with these Specifications.

Construction Requirements

Lime concrete shall consist of a mixture of 2 parts lime to 2 parts surki and 7 parts brick chips.

Lime shall be unslaked lime and shall be mixed by weight. Lime weight shall be measured at Unslaked Condition and one cubic meter of lime terracing work requires 4.60 mounds (172.16 kg) of lime. Slaked lime shall be screened through 3.35 mm sieves and the residue shall be rejected. The lime stone should be brought to site and slaked in the ground of the working place.

Surki shall be made from 1st class (well-burnt but not vitrified) bricks crushed or ground to pass through a 2 mm sq mesh.

Brick chips (khoa) shall consist of 18 mm down-graded angular fragments of broken or crushed 1st class bricks.

The mixing shall be done on a clean platform but not on roof. Lime and surki in the specified quantities shall first be mixed dry till the mixture is of uniform colour. Then the mixture shall be screened. Specified quantity of previously wetted khoa shall be added .and the whole turned over once without adding water and twice by gradually adding small quantities of water for tempering. The mix shall then be allowed to age for at least 7 days. During this period the mixture shall be turned by spading twice a day and further lime water added if needed to prevent drying up. Care should be taken to keep it under cover to protect against rain. The mixture shall then be laid evenly on the roof slab to proper slope and in thickness 30% more than that shown on the plans and thoroughly beaten for 7 days with wooden mallets to the finished thickness and proper slope. Before beating a lime slurry shall be laid on the top and allowed to soak well. The lime water mixed with molasses shall be continually sprinkled on the concrete to keep it wet while being beaten. Beating should not be stopped until the metallic sound is obtained. The mortar which comes to the surface during the beating is to be rendered smooth and finished off with lime rubbing. The terracing shall be kept wet after completion for a period of not less than one week. The soundness

of the lime terrace roof should be tested by cutting a small portion of the materials 75 mm square and 50 mm deep in few representative areas and filling the holes with water and observing for half an hour. If the water level does not go down in any of the holes the compaction of the L.C. shall be considered to have been adequate. If not, the L.C. shall have to be done again.

5.25 Screeding on Roof

Description

Average 50mm thick screeding with concrete on top of roof slab with cement, sand (FM 2.5) & 12mm downgraded stone chips. Concrete is to be laid in slope as per drawing and direction of the Project Manager.

5.26 Surface Drain

Description

The item shall consist of 300 mm or 450 mm deep drains in accordance with these specifications.

Construction Requirement

Bricks, cement, sand and all other materials shall conform to the requirement of respective materials specified in the relevant sections of materials specifications.

The surface drain shall be constructed in true line and level as per drawing and direction of the Project Manager.

300 mm deep drains shall have 300 mm clear width with 125 mm thick brick wall (1:6) on 75 mm thick cement concrete (1:3:6) base over single layer brick flat soling. The exposed surface shall have 12 mm thick cement plaster (1:3) with neat cement finishing and curing at least for 7 days must be done.

5.27 Apron

Description

The item shall consist of construction 50 mm thick cement concrete over a layer of Brick flat soling around the structure in accordance to this specification.

Construction Requirements:

Cement Concrete (1:2:4) with neat cement finishing.

Brick flat soling by first class bricks unless otherwise specified.

Sand shall be clean well graded natural sand having F.M of 2.0 for concrete.

Water shall be same as required for concrete.

The area specified for construction of apron shall be thoroughly cleaned, leveled & compacted to proper slope & level. Brick flat soling shall be laid over compacted earth according to specification no. 2.6, then cement concrete (1:2:4) as per specification no. 2.7 shall be placed over BFS with maintaining proper level & slope towards drain, Simultaneously neat cement finish shall be applied on top surface curing for a period of at least 7 days as prescribed in item no. 2.7 complete as per drawing & direction to the Project Manager.

5.28 Road Work

The proposed substation sites are located in different parts of Bangladesh. These are the low lying area mostly are paddy land. The proposed substation sites may be connected by a road which shall be constructed during construction period.

The Construction work of roads shall be carried out in accordance with the Drawing. The design and drawing shall be as per AASHTO specification. However, demolition and restoration of the public roads (including private roads) shall be carried out according to the specifications designated the official in charge of road management notwithstanding the provisions described in the specifications and the Drawing.

5.28.1 Road Work Inside The Premises

Sub-grade

- a) Any excavation and banking work required for sub-grade construction shall be carried out in accordance with the respective provisions in General Provision of earth work.
- b) The material required for banking and displacement shall be so placed that the finished thickness of one layer after compaction shall become 20 cm or less.
- c) The sub-grade surface shall be finished by proof- rolling in order to obtain the contact pressure sufficient to permit smooth traffic of vehicles of 8 tons or over should any defects be detected as a result of proof-rolling, such defective sub-grade surface shall be finished again to the satisfaction of the Project Manager.
- d) The finished sub-grade surface shall be within + 5 cm of the design elevation.

Sub base Course

- (a) The materials to be used for sub base course shall be in accordance with the specification described in the Drawing. The Contractor shall submit a report concerning the quality of materials and the methods of sampling to the Project Manager for approval.
- (b) The finished surface of sub base course shall be within –10 mm and +5mm of the design elevation.

Surface Course (Asphalt pavement) – Approach/Access Roads

- (a) Prior to commencing pavement, the sides of concrete side walk, manhole, etc. shall be cleaned, and molten asphalt, etc. shall be coated over the sides.
- (b) The surface to be seal-coated and prime- coated shall be finished into even level, and after perfecting removing any bloc, dust and other foreign matters, such surface shall be cured and dried.
- (c) The mixtures shall be spread uniformly, rolled and finished into the specified thickness. Then, the finished surface shall be measured in parallel to the center line of the road by using a 3 m straight line ruler. In this case, the depth of any concave sections shall not exceed 5 mm.
- (d) The Contractor shall submit a report on the materials to be used for pavement of surface course and method thereof to the Project Manager for approval.

Inspection

The Contractor shall invite inspection by the Project Manager during the course and after completion of sub base course and surface course works.

5.28.2 Public Road (Including Private Road)

(1) Demolition of Pavement

Demolition of Pavement for public roads including private roads shall be carried out so carefully as not to cause any hazardous effect upon the surrounding portions of cement, concrete or pavement.

(2) Road Keeping and Restoration

(3) The road keeping shall be of a construction applicable to the prevailing site conditions and so provided as not to cause any danger or trouble against traffic.

(4) The Contractor shall submit the drawings for road keeping to the Project Manager for approval.

(5) The Contractor shall constantly patrol any spots of road keeping and exert his utmost efforts perform maintenance and repair of such roads in order to eliminate any trouble against smooth traffic.

(6) The Contractor shall carry out maintenance and repair of any pertinent roads so carefully as not to cause any trouble against smooth traffic until the said roads have been restored and taken over to the official in charge of road management.

5.28.3 Herring Bone Bond Brick Pavement

Description

This work shall consist of a base composed of bricks, laid on edge in a herring bone pattern, placed on a prepared single layer brick flat soling in accordance with these specifications and to the lines, grades, levels, dimensions and cross section shown in the drawings and as required by the Project Manager.

Materials

The materials shall consist of first class bricks.

Construction Methods

The bricks shall be laid either flat or on edge with the shortest side vertical , in a single layer in a herring bone pattern to the lines, grades, levels, dimensions and cross section shown on the drawings and as required by the Project Manager. The edges/lines of the layer shall be made with cut bricks to produce a line which is compatible with brick soling. The joints shall be filled with sand brushed in and the completed layer shall be sprinkle liberally with water

5.28.4 RCC Pavement – Internal Roads.

Description

The item shall consist of constructing R. c.c. road with 250mm thick guid wall of height 0.30 meter and 150mm thick R.C.C. work over one layer first class brick flat soling and reinforcement 10mm dia M.S. rod @ 175mm c/c in both direction.

Reinforcement

In pavement shall be placed and secured as shown on the plans in accordance with the requirements of item 2.12.

Construction and expansion joints

Shall be constructed exactly in accordance with the details shown on plans and with best workmanship and as per direction of the Project Manager.

Extreme care shall be exercised in placing, compacting and finishing concrete at the joints to prevent displacement of the joints and to avoid the formation of honeycombs and voids. The concrete along the joints shall be thoroughly consolidated by the use of vibrators.

As soon as the concrete is sufficiently hardened, the edges of the pavement, the longitudinal joints, the construction, and expansion joints shall be carefully executed as per drawing and direction and finished with an edging tool so that the radius shown on the plans is obtained.

Curing and protection

Shall start as soon as newly-laid pavement is sufficiently, hardened and shall be continued for a period of at least 7 days as prescribed in item no. 2.10

After hardening of concrete the joints shall be cleaned and filled with sand bituminous mastic to the satisfaction of the Project Manager.

5.28.5 Laying of Curb Stone (Concrete Block)

Description

The work covered by this item shall consist of providing and laying curb stone in sidewalks, driveways, road islands, garden paths, parking areas, etc. as per manufacturer specification, drawings and direction of the Project Manager.

Materials

Materials shall meet requirements specified below and in accordance with the specifications.

Curb stone shall be with concrete class C18.

The mortar for joining shall be 1:2 cement mortar.

Installation Requirements

Preparation of bed, laying and joining shall be as per manufacturer specification.

5.29 Clearing after Completion

The Contractor shall thoroughly clean all work upon completion. Clean off all stains, marks, spots, and disfigurements from all works, touch up as required, clean all window panes, remove all rubbish and debris from building and site and leave premises clean and tidy and fit for occupation in all respects and to the entire satisfaction of the Project Manager.

5.30 AS Built Drawings

The Contractor shall prepare as-built drawings for entire project after completion of Construction, installation and all tests, and obtain approval from Owner/Consultant, and shall submit 3 (three) set of such as-built drawing to the Owner for keeping record. Minimum one computer soft-copy shall be accompanied with the as-built drawings.

5.31 Tests for Materials

The following tests for the construction materials shall be performed.

5.31.1 Sand

At least two samples shall be tested for each consignment but not exceeding 275 cum.

- a) FM
- b) Percentage of clay lump
- c) Mica content
- d) Organic Impurities
- e) Material finer than # 200

5.31.2 Brick

At least 6 bricks to be tested for each consignment not exceeding 50,000 no. of brick.

- a) Unit weight
- b) Compressive strength c)
Water absorption
- d) Dimensions
- e) Efflorescence, if necessary

5.31.3 Reinforcement

Each set of sample shall consist of 3 (three) representative standard pieces of Deformed bar for each size for each consignment or as directed and shall be tested for the following properties:

- a) Yield or 0.2% Proof strength test b)
Ultimate tensile strength test
- c) Elongation
- d) Bend test
- e) Cross section area

f). Unit Weight/meter

5.31.4 Stone Chips

At least two samples shall be tested for each consignment but not exceeding 600 cum.

- a) Gradation b) Unit weight
- c) Specific Gravity
- d) Los Angeles Abrasion Test.

5.31.5 Cement

At least 3 samples of cement shall be tested for each consignment but not exceeding 100 tons.

- a) Fineness
- b) Setting times
- b) Compressive strength for 3rd, 7th and 28th day

5.31.6 Concrete

For all concrete work at least 3 (three) sets of 3 (three) samples cylinder/cubes and for each days casting or for each 15 cum of concrete shall be preserved and tested to for 7 days and 28 days crushing strength.

5.31.7 Water

Sulphate and Chloride content shall be tested for construction works of each site.

5.31.8 Where Tests to be Done

All tests shall be performed in the BRTC of BUET or any other laboratory approved by the Project Manager.

5.31.9 Cost of Tests

The cost of making any test shall be borne by the Contractor if such test is clearly intended by or provided for in the specifications or Bill of quantities and is required to ascertain whether the design of and / or quality of any finished or partially finished work is appropriate for the purposes which it was intended to fulfill and conforms to specifications.

5.31.10 Building Furniture

The required building furniture is listed on the drawings. The final specification of the supplied furniture shall be to the approval of the Project Manager.

B. CIVIL

6.0 BUILDING, SANITARY AND ANCILLARY FACILITIES

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6.1 Plumbing Fixtures

6.1.1 Water Closets

Description

The work shall covered by this item shall consist of furnishing and installing white-glazed vitreous china water closet (WC) long pan/commode/Combi closet in accordance with these specifications.

Construction Requirements

Water closet (commode/Combi closet} shall be "S" or "P" type with low down cistern of vitreous China and shall be standard product of Bangladesh Insulator and Sanitary ware Factory (BISF) Ltd/International- standard complete with seat and cover shall be made of formal dehyde molding compound of VICTORY brand/ equivalent of approved quality. Size of commode shall be as per requirements of schedule of item.

Long Pan Shall be squat type as per BISF/ International -standard with integrated foot rests and shall be as specified in schedule of item.

Low down Cistern for commode/Combi closet/long pan shall be BISF/ International standard quality cistern of size 550mm x 260mm x 375mm and capacity 12.00 liters.

Cistern For long pan shall be overhead 13 liters type (MAANCO/ BISF/ International Standard or approved equivalent) complete with float valve, fittings and fixtures as per requirements of schedule of item.

Angle stop shall be as per drawing and instruction.

Pans shall be fixed to the floor with 1:2 cement mortar in case of squat type and with 4 nos. CP round headed screws in case of pedestal type.

Cistern shall be secured to the wall by 2 nos. #14 CP round headed screws and supported on centre bracket fixed to the wall with 2 nos. #14 CP countersunk screws. Cistern shall be connected to water supply with 12 mm plastic connecting pipe and CP angle stop.

6.2 Wash Basins

Description

The work shall covered by this item shall consist of furnishing and installing white-glazed vitreous china wash basin on wall and supported by concealed wall hangers and fitted with chrome-plated 30 mm waste, bottle trap and waste pipe, 12 mm angle stop and pillar faucet, chain, stay, rubber plug and 12 mm plastic supply connector pipe in accordance with these specifications.

Construction Requirement

Wash basin shall be of BISF-standard colour and size as specified in schedule of items.

Pillar faucets and angles stops shall be 12mm bore chrome plated brass and be of best quality (king size) Bangladesh made prior approved.

Traps (Syphone : dismantle type) shall be 30mm bore Chrome plated copper alloy having at least 75mm water seal and shall be priority approved best quality Bangladesh made.

Waste pipe shall be of 30mm. PYC pipe best quality available for sewer grade.

Basins shall be supported on 2 concealed wall hangers. The basin in the executive/Master toilet room shall be provided with pedestal: 652mm x 204mm x 204mm size BISF standard coloured.

Hangers shall be screwed to hardwood plugs built in the wall using 3 nos 14 countersunk screws for each hanger. Hangers shall be painted with 2 coats of oil paint, over a coat of red lead primer or shall be galvanized.

Taps, valves and traps shall be connected with water supply installation by means of standard unions, coupling nuts and fittings.

6.3 Kitchen Sink

Description

The work covered by this item shall consist of furnishing and installing Kitchen sink and tray on bracket in accordance with these specifications.

Construction Requirements

Kitchen sink and tray shall be Stainless Steel as per requirements of schedule of items. The construction requirement shall be similar to Wash Basin.

6.4 Soap Tray

Description

This item covers the supply and installation of soap tray as per following requirement.

Requirements

The soap tray shall be C. P. cast iron of standard size best quality Bangladesh made (as approved) and should be fixed in wall by drilling & fixing by screws etc. all complete. The dimension shall be 150mm x 110mm x 40mm.

6.5 Toilet Paper Holder

Description

The work covered by this item shall consist of furnishing and installing Toilet paper holder in accordance with these specifications.

Construction Requirements

Toilet paper holder shall be of approved quality as specified in schedule of item. The holder shall be fixed with chrome plated brass screws to plugs built in the wall.

6.6 Glass Shelf

Description

This item shall cover supply and installation of glass shelf 5mm as per schedule of item fm: basins & toilets as per following requirements.

Requirements

The glass shelf shall be best quality local made (Priority approved) with C. P. or stainless steel supports & guide rails and should be fitted in the wall with screws etc. complete.

6.7 Towel Rails

Description

The work covered by this item shall consist of supply of towel rails and installation of the same as per following requirements.

Requirements

The towel rails shall be chromium plated heavy type 20mm dia 600mm long with C. P. flanged holder, counter sunk screws. The rail should be fixed in walls by drilling holes in wall, fixing screws through rowel plug to the satisfaction of the Project Manager.

6.8 Mirrors

Description

The work covered by this item shall consist of furnishing and installing plate glass mirrors Japan/Belgium of approximate dimensions 450 mm x 350 mm and of 5 mm thickness over lavatory basins according to these specifications.

Construction requirements

Edges of mirror shall be clean cut and round smooth. Mirror shall not be installed in direct contact with the wall. The separation shall be effected by 6 mm thick rubber or cork spacers. Fixing shall be by means of chrome-plated holders and screws to hardwood plugs built in the wall. Care shall be taken to place the mirror symmetrical to the axis of the basin and with sides vertical and horizontal.

6.9 Shower Rose

Description

The item shall consist of furnishing and installing chrome plated brass shower rose in accordance with these specifications.

Construction Requirements

The shower rose shall be of nominal 100 mm diameter best quality Bangladesh made prior approved and shall be connected to the water supply installation by screwing giving a leak-proof joint.

6.10 CP Grating

Description

The work covered by this item shall consist of furnishing and installing chrome-plate gratings in accordance with these specifications.

Construction Requirements

CP grating shall be 125mm dia. heavy type and approved quality and shall be installed in direct contact with the floor.

6.11 CP Bib Cock

Description

The item shall consist of furnishing and installing chrome-plated brass bib taps in accordance with these Specifications.

Construction Requirements

Bib taps shall be of 12mm bore heavy type with at least 75 mm projection and shall be best quality Bangladesh made (Nazma, Sharif or equivalent) prior approved Draw-off taps and stop valves for water services!

Taps shall be connected with the water supply installation by means of standard unions, coupling nuts and fittings.

6.12 CP Stop Cock

Description

The work covered by this item shall consist of furnishing and installing chrome-plate stop cocks in accordance with these specifications.

Construction Requirements

The stop cock shall be 12mm dia heavy duty chrome-plated concealed and shall be approved quality Bangladesh made (Nazma, Sharif or equivalent).

Stop cock shall be connected with the water supply installation by means of standard unions, coupling nuts and fittings,

6.13 G.I. Water Pipes and Fire Stand Pipes

Description

The work covered by this item shall consist of supplying and installing galvanized steel water pipes on wall surface or in wall, underground through stack (duct) and where necessary in accordance with these specifications.

Constructional Requirements

GI pipes shall be galvanized steel welded tubes of screwed and socketed type, Class A and shall be equivalent to as specified in BS-1387.

Stop valves

Shall be of brass and equivalent of the screw down pattern conforming to as specified in BS-1953.

Draining

Staps shall be screw-down pattern conforming to BS-2879.

Ball valve

Shall be of brass and conform to BS- 1212.

Float for ball valve

Shall be of copper with solder joints and conform to the requirements of Class A, BS-1968.

All fittings shall be standard GI products and shall conform to BS-534.

The piping work shall be carried out in accordance with British Standard Code of Practice CP-310 Water Supply!

Pipes shall be jointed with preferably with raplon tape according to manufacturer's instructions. However, strands of find jute may be used with the approval of the Project Manager.

A gate valve along with a float valve shall be provided with a socket union where the service pipe from main is connected to the underground reservoir.

Stop valve shall be provided on the supply pipe to individual buildings in an accessible position inside the building as near as practicable to the point of entry of the pipe to each building so that the supply may be readily shut off for repairs. A draining tap shall be provided just above the stop valve to enable the service piping in the building to be emptied of water when stop valve is shut. Stop valve shall also be provided at the outlet from roof storage tank and on every branch pipe of the feed pipe as near as possible to the point at which the pipe leaves so as to minimize interruption of supply during repairs.

Where the service pipe is less than 50 mm bore, all the stop valves shall be of the screw down type. Other stop valves shall be of the gate type.

Pipe in structures shall be installed during construction. No hole or chasing in wall or floor shall be allowed without prior approval. Pipes shall be supported by steel clips placed at an interval of approximately 1 meter. All clips and brackets shall be fixed with rawal plugs into the masonry.

The fire stand pipe shall be 4" dia G.I. unless otherwise specified. Each floor shall be equipped with fire hose, made of rubber lined cotton 63mm diameter. Rubber covered or unlined linen may be provided with the approval of the Project Manager. A closet in which hose is stored should be ventilated and installed at least 1300mm above the finished floor. The hose is to be equipped with 25 to 33mm nozzle.

The joint shall be made with hose coupling. The length 63mm hose should be about 30m. This length, measured around obstruction and partitions, should make possible the use of nozzle within 10m of every part of every floor in the building. Two such closets with hose are to be provided for each floor in each tower as shown in the drawing.

A hose valve is to be installed close to the water supply pipe (stand pipe) between it and the hose. The gate valve so equipped shall have thread that are interchangeable with those used by the local fire department.

Since the stand pipes in the building are supplied from roof tank, they are to be linter connected at the top as shown in the drawing.

Fire department hose connections shall be provided with an approved straight may check valve located in the value pit (or the building), but not with a gate valve. Check valve shall be of the approved extra heavy flanged rattern or as required by the local fire department.

Piping outside building shall be laid underground and the depth of cover measured from the top of the pipe to the finished surface of the ground shall not be less than 750 mm where the pipe passes under roadways or through structures, a min. 100 mm RCC sleeve shall be fixed to allow freedom of movement.

The Contractor shall carry out and provide as part of the contract all excavation in any kind of soil encountered for laying pipes to the required depths. No tunneling shall be done except with the consent of theProject Manager. Where necessary the Contractor shall support the sides of the pipe trench by suitable timbering, bail out water, remove spoil and backfill to make up level with sand FM 1.0 without extra cost. Backfilling shall be carried out as provided under item 2.5.2 of Spec. civil.

After installation the pipe system shall be hydraulically tested for two hours at a pressure .equal to 50 psi without showing any sign of leakage.

6.14 PVC Sewer Pipes and Fittings

Description

This item shall cover the supply & installation of PVC for conveying away soil water from sanitary filaments, waste and rain water pipes with supply of fittings as may be necessary according to the following requirement.

Requirement

The PVC waste and rain water pipes & fittings shall comply with ASTM D2729-89 for different diameters and joints should be made to comply with ASTM D267289, ASTM D2855. Pipes shall be jointed to each other by using suitable solvent cement recommended by the manufactures. Installation of PVC pipes indirect sunlight is not permitted. Once the joints are made, they should be left undisturbed for 12 hours for the solvent cement joints to attain its strength.

6.15 UPVC Soil and Waste Pipes and Fittings

Description

The item shall consist of supplying and laying cast-iron pipes for conveying away soil water from sanitary filaments.

Construction Requirement

Cast-iron pipes, shall be equivalent to that specified in BS-416 'Cast -iron spigot and socket soil waste and ventilating pipes (sand cast and spun) fittings and accessories;

The sanitary pipe work shall comply with British Standard code of practice CP-304.

All pipes shall be aligned properly, laid to specified slope (1 in 100) and securely fixed to the structure above the false ceiling by using ears on pipe sockets or cast-iron/G.I. holder bars or purpose made straps.

Cast-iron spigot and socket pipes shall be joined to each other with tarred-jute packed in half the depth of tile socket, while the other half shall be filled in with molten lead properly caulked and furnished. All joints shall be made perfectly air and water tight. Joints shall not be embedded in the structure without prior approval. All pipes to be furnished with cement grouting internally and to be bituminous painted externally.

All junctions shall have back or side door for inspection and clearing.

All necessary fittings such as cowls, gratings, bends, tees (plain or door), offsets (plain and door), sockets, traps, Y -Tees (plain and door), loops, and siphon with horn shall be furnished and fixed at no additional cost to the Contract.

Traps shall have a minimum water seal of 75 mm for pipes up to and including 50 mm dia and minimum water seal of 50 mm for pipes over 50 mm dia. Floor channel drain shall have properly trapped outlet fitted with a removable grating. After installation, water seal tests are to be made to check against any leakage before backfill.

6.16 RCC Pipes

Description

The item shall consist of supplying and laying underground reinforced cement concrete pipes for sewerage and drainage and connecting to existing sewer or to the septic tank in accordance with these Specifications.

Construction Requirements

Concrete pipes shall have a minimum barrel thickness of 14 mm and conform to BS. 556.

Granular bedding shall consist of 12 mm down-graded brick chips.

Cement shall be Portland cement Type-I ASTM C-150, or BS-12

The work shall be carried out in accordance with British standard code of practice CP-301 'Building Drainage' and CP-2005 Sewerage. Pipes shall be laid in trenches at depths and slopes shown on plans. Unless otherwise specified the pipes shall have a slope of 2%. The pipes shall be laid in a straight line and at one gradient between manholes. No bend pipe shall be allowed. Inspection chamber shall be provided at all change of direction and gradient on pipe except where such change is not too large for cleaning. Manholes or inspection chambers shall also be provided at all pipe junctions where cleaning is not otherwise possible. The distance between the access

points in no. case shall exceed 50 meter. All branch pipes shall meet with the main line at manholes. No branch shall be permitted to enter into the main without inspection chamber.

The centre line and width of trench shall be accurately set out established by means of suitable pegs and reference points. Where the width of the trench is not specified it shall be 300mm greater than the external diameter of the pipe.

No less than 3 sight rails shall always be fixed by appropriate surveying method on each length of trench at any gradient to control excavation and laying.

The trench bottom shall always be kept free from water by suitable drainage and dewatering if necessary and the walls shall be supported by adequate timbering where so required. Excavated material shall be deposited at a safe distance from the edge of the trench so as not to endanger the stability of excavation. All pipes, ducts cables, mains or other services exposed in the trench shall be effectively supported by suitable means.

Where works are to be executed in the public highway, excavation shall be arranged in agreement with proper authority so as to cause the minimum obstruction to traffic. Proper warning and directions to traffic shall be given.

Trench shall be excavated and trimmed to a depth 150 mm below the invert level of the pipe. Pipes shall be laid on granular bed which shall extend to the full width of the trench to a thickness of 150 mm and adjusted to ensure exact line, level and uniform bearing. If the formation is in-advertently low at any point, it shall be brought up to the correct level by granular fill to ensure uniformity of pipe support. Soft spots, obstructions, and large roots shall be removed and tamped-in solid with approved fill to the satisfaction of the Project Manager with additional cost of material.

In short connection runs, where the ground is not wet and allows the trench formation to be trimmed so as to provide a uniform and solid bearing, the pipes may be laid upon the formation directly. The pipes shall be mortar-jointed using a 1:3 cement-sand mortar. Before mortar is inserted, a gasket of tarred yarn shall be caulked into the joint. Ends of the pipe shall be wetted immediately before jointing. Newly made joints shall be kept damp and protected from weather and disturbance until covered by the backfill. The interior of the pipe shall be examined as each joint is made and any intrusion of mortar or gasket removed. Where it is necessary to cut pipes this shall be done with a suitable tool so as to leave a clean end, square to the axis of the pipe.

Connection to the existing sewer and excavation around it shall be done only with express consent and in accordance with the instructions of the local authority. After installation, water seal tests are to be made without showing any leakage before backfill.

Backfilling shall be with sand F.M 1.0 built up in layers not exceeding 150 mm. Filling shall proceed downhill and in all other respect comply with the provisions of item 2.5.2 of Spec. civil.

All surplus excavated material shall be disposed of to the satisfaction of the Project Manager.

6.17 Inspection Chambers with RC.C Cover

Description

The item shall consist of constructing inspection chambers, on the underground drainage and sewerage lines where necessary, of dimensions as indicated and of suitable depth, in accordance with these specifications.

Construction Requirements

Materials shall conform to the requirements set forth below and in the relevant sections of the Material Specifications.

Bricks shall be 1st class solid bricks.

Cement shall be Portland cement Type-I ASTM C- 150 or BS-12

Stops irons shall be of galvanized malleable cast iron complying with requirement of BS1247 or of mild steel galvanized after manufacture by hot-dip process.

R.C.C cover and frame for manhole shall be of dimensions shown on the plans.

Excavation shall be as stated in item 2.5 of Spec. civil.

Brick flat under base concrete shall be as stated in item 2.6 of Spec. civil. Concrete for base shall be constructed as stated under item 2.10 of Spec. civil.

Brickwork shall be as stated in item 2.13.1 of Spec. civil, & 2.13.2 of Spec. civil constructed of 1st class bricks and (1:4) or (1:5) cement mortar as per requirement.

Plaster shall be as stated in item 2.16.1 of Spec. civil, 2.16.2 of Spec. civil and consist of (1:4) or (1:5) cement mortar as per requirement.

Brickwork of chamber shall be built in English bond with watertight joints. The inside shall be rendered with a neat-cement finished 12 mm thick coat of cement plaster and the exterior shall be flush pointed. The cover frame shall be correctly positioned and, cast-in during concreting.

Backfilling shall be done after at least 7 days of curing of brickwork and shall comply with the requirements of item 2.5.2 of Spec. civil unless otherwise permitted to use the excavated material.

6.18 Water Tank

One overhead tank shall be provided for each substation the minimum requirements for which is provided below:

The tank should be of Blow Molded fabrication and should be strong and long lasting with a U. V. Stabilizer. The capacity of the tank shall be 2000 liters (440 Gallon). It should be installed on the concrete roof of the building. It should be capable of withstanding a temperature of 110⁰ C.

6.19 Water pump

The water pump provided must be of the submersible type and should be capable of functioning satisfactorily under the particular site conditions. As a minimum it should conform to the particulars below:

Submersible AC Motor

Technical Particular's	BREB Specification
General Description	Pressure balanced submersible AC motor.
Motor type	Highly efficient 3 Phase AC motor
Internal filling	Water filling
Lubrication	Water lubricated
Electronics	Any electronics must not be inside the submersible motor
Bearing	Water lubricated slide bearing axial bearing: Carbon ceramic
Wetted material	Stainless steel (AISI304 or higher), Rubber (Drinking water approved)
Voltage	3×100V electronically commutated
Input Voltage	440 V
Submersion limit	300 M
Rated Power	Minimum 3.70 KW
Rated Speed	1150 to 3425 RPM
Warranty	05 years or above.
Efficiency	92% or better

Submersible Pump end

Technical Particular's	BREB Specification
General Description	Submersible multistage centrifugal pump
Back flow protection	Non return valve
Dry run protection	Preset
Material	Body: Stainless steel (AISI 304) Impeller: SS (AISI 304)
Maximum flow rate	130m3/hr
Minimum borehole diameter	152mm minimum
Average daily flow at the static head and Bangladesh insulation condition	200,000 Litres per day.

Note: In Support of offered Specification, Printed Catalog must be submitted by bidder.

B. CIVIL

7.0 INTERNAL AND EXTERNAL ELECTRIFICATION

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7.1 Scope of Work

The electrical installation for each site comprises electrical wiring of light, fan, small power, ventilation power, water pump and all other utilities power supply in the substation building, switchyard, guard room and parking area. There shall be two types of power supply 415 V, 240 V 50 Hz i.e. 3-phase 4-wire and single-phase 2 wire.

The Contractor shall have to submit shop drawings on the basis of Consultants drawing for the project for each and every item of work. The Contractor shall submit at least one month prior to start of the particular part or parts of their work to the Project Manager for approval. Similarly the brand, country of origin, design and /sample of all equipment, material, fitting etc. as applicable and which are required for the building, either local or imported item shall have to be approved by the Project Manager. Before taking the item at site or before placing order (for imported items) for procurement, manufacturing etc. or shall be carried out without having such approval.

The bidder shall specify brand name, country of origin, model number etc. of all equipment and material and also attach original catalogue with the bid.

Scheduled quantity may vary as per site requirement. Quantity of some items have been shown as unity. These are only for fixing rate, in case these items are required to be executed, to avoid NT (Non Tendered Item).

7.2 Standard, Code & Regulation

The installation in general shall be carried out in conformity with the Electricity Rules of the Govt. of Bangladesh, Bangladesh National Building Code [BNBC] and the 16th edition of the Regulation for Electrical Equipment of Buildings of the Institute of Electrical Engineers (U.K), hereinafter referred as I.E.E. wiring Regulations, and the British Standard Code of practice for the relevant works. Any special requirement of the Electrical Inspector, Govt. of Bangladesh or the Power Development Board, Dhaka Electric Supply Authority, Dhaka Electric Supply Company, or the Telegraph and Telephone Board, or any other Legal Authority shall also be complied with no extra cost to the Employer.

The following standards, in addition shall be followed for design, manufacture, installation, testing and commissioning of wiring and the communication system of this project:

Bangladesh National Building Code	BNBC
International Electro technical Commission	IEC
Institute of Electrical and Electronics Engineers	IEEE
National Electrical Manufacturers Association.	NEMA
German International Standard	VDE
International Standard Organization	ISO
Japan International Standard	JIS
British Standard	BS

7.3 System Structure, Equipment and Installation

7.3.1 Conduit Work

7.3.1.1 Metal Conduit

Metal conduits shall conform to B.S. 4568 part 1 & part 2, or B.S. 31:100, and shall be 18 SWG (minimum) thick, either solid drawn or formed and then welded. In the later case, the bore must be free from any burs. The conduits shall be black enameled or galvanized. The steel shall be such that when bends are formed, the conduit shall not break, crack, or be deformed. Appropriate sample shall be submitted prior to installation of conduit.

G.I. Conduit

GI conduit shall be used in sized grade as shown on the drawing. Inside surface of the pipe must be free from any burs. All G.I. bends shall be preformed and shall be of same materials as the pipe. Recommended specifications of GI pipe are as follows:

<u>Nominal pipe size (mm)</u>	<u>Outside dia. (mm)</u>	<u>Inside dia. (mm)</u>	<u>Wall Thickness (mm)</u>	<u>Weight of pipe (kg/m.)</u>
25	32.875	26.225	3.325	2.50
37.5	47.5	40.25	3.625	4.05
50	59.375	51.675	3.85	5.45
62.5	71.875	61.725	5.075	8.63
75	87.5	76.7	5.40	11.28

Junction box, Pull box, Circular box, etc.

Junction box and pull box should be made of 16 SWG (minimum) galvanized steel sheet or any other materials as directed by the relevant authority depending on where it is installed, and to the satisfaction of the Project Manager, to match with the existing construction in which these are installed. The circular box shall be of brass/PVC. Circular boxes made of aluminum are not acceptable. The cover (metallic or plastic) of the metallic box should be fixed by using countersunk brass screws or galvanized machine screw. Box ears shall be at least 14 SWG, Each box (except circular boxes) must have an earth block of copper or brass of appropriate size (minimum), being for one earthing lead, 3/8"x3/8"x3/8" (10mrnx10mrnx10mm) block with 3/16" (M5) drilled hole and 1/8" (M3) machine screw tapped for 24 t.p.i. where earth continuity conductors shall be screwed in. The circular box shall have at least 1/2" (12mm) long hub.

Appropriate samples shall be submitted prior to installation of these boxes.

Conduit/Pipe Bends

Wherever possible, instead of using bends, the conduit should be bent to the required angle using pipe bender. The minimum bending radii shall be such as to allow compliance with standard specification for bends in cables, and in addition the inner radii of bends shall not be less than 2.5 times the outside diameter of the conduit.

Cable Bending Radius

The recommended bending radii are given below:

<u>Dia. of Conduit</u>	<u>Radius of Bends</u>
20mm	125mm
25mm	150mm
32mm	200mm
38mm	225mm

If the situation warrants use of separate bends for conduit shall be made from 18 SWG steel, black enameled or galvanized. Aluminum bends must not be used Brass/PVC bends are acceptable. No inspection bends shall be used and at places where inspection is required, steel boxes shall be used.

Separate bends shall be used only after obtaining approval of the Project Manager.

In case of G.I. pipes, long radius preformed bends of the same materials and of required angle (22.5°, 45°, 60° & 90°) shall be used.

G.I. pipe may be bent to required angle only after obtaining written approval of the Project Manager.

Conduit Termination and Fittings

At the end of a run, the conduit/G.I. pipe must terminate in a metal box, galvanized or black enameled. When a conduit is terminated in a metal box (except circular boxes), a smooth bore brass/PVC bush or ring bush must be used along with brass lock nuts of the following specification or its metric equivalent:

LOCK NUT

Conduit size (mm)	Thickness (mm)	O.D. (mm)	No. of threads
19	1.56	28.125	3
25	4.68	31.25	3

BUSH

Conduit size (mm)	C.D. (mm)	Length (mm)	No. of thread	Length of smooth bore at end (mm)
19	21.875	8.59	4	1.95
25	28.125	10.54	5	2.73

Installation

Metal / G.I. Conduit

In general, conduit pipes shall have surface installation at the truss member and shall be placed under the truss member to the satisfaction of the Project Manager.

Conduits of each circuit must be completely erected before any of the cables are drawn in. The pipe run should be continuous throughout its length, and kept straight as far as possible. It should run either horizontally or vertically, and never at an angle. The conduits are to be properly welded with the truss member at 1 Meter spacing using appropriate welding electrode and other consumables. If the pipes are installed exposed in wall/over false ceiling these shall be placed over 10mm space pipe diameter and clamped with saddle or M.S. flat bar 25mmx3mm at 1 meter spacing using rope plug/ rowel bolt to the satisfaction of the Project Manager at no extra cost to the Employer.

All pipe runs should be kept clear of gas, air and steam pipes, and pipes of other services. To avoid other service pipes, the pipe should be either routed or set out so that at least 75mm separation is maintained between other pipes and electrical pipes. Conditions other than those stated above, if encountered by the Contractor, must be brought to the notice of the Project Manager for instructions.

Pipes installed in ground / R.C.C. Floor shall be placed at the time of construction to the satisfaction of the Project Manager.

Pipes installed in R.C.C. Wall and column shall be placed at the time of construction of the wall. No cutting in wall and column shall be allowed without prior approval.

7.3.1.2 PVC Conduit

PVC conduit must conform to NEMA TG2 or equivalent designed for installation of reinforcement and before casing in slabs, or exposed. These shall be heavy wall rigid type-40. The minimum dimensions shall be as per schedule of items and bill of quantities.

No PVC fittings shall have wall thickness at any point less than 2mm.

Installation

PVC Conduit

In general, conduit pipes shall be installed as per item 4.1.3.1. Where PVC conduit uses fittings made of PVC fiber or other insulating materials, these shall be press fitted and then sealed with PVC solvent cement. Where metal fittings are used thread PVC pipe may be made by using the threads on the fittings as a die.

All exposed PVC pipe runs up to a height of 2 Meter from the floor shall be protected by a metal enclosure.

PVC pipes shall be bent either by using a pipe bending guide lines as detailed in item 4.1.3.1 or by using a hot-box bender or by using a flame. In any event, the bending radii shall conform to relevant portion of item 4.1.3.1 and the bend must be well formed and be without reduction in internal diameter.

Conduit / Pipe in Floor

All conduit / pipe shall be installed having a slope of 1:1000 towards the floor mounted pull box or cable duct so that condense or leakage water drains out easily to the pull box or cable duct. For runs of more than one conduit in the same floor the direction of slope of different conduits should be decided in such a systematic manner as to ensure an uniform drain out of the leakage. All socket joints shall be made water tight.

No U-bend in floor shall be installed.

7.3.2 Cable Work

Material:**Single Core Cable:**

Single core low voltage cables and conductors shall be as per BS-6004, BS2004 and VDE 0250, 0271. Conductors shall have 450/750 Volt grade (for BYA cable) and 300/500 Volt grade (for BYM cable) of PVC insulation. All cables shall be multi strand type unless otherwise specified. All flexible cables shall be as per BS-6004 unless otherwise specified.

Multi Core Cables:

Multi-core low voltage cable shall be PVC insulated PVC sheathed copper conductor, termite proof, made and tested according to VDE 0250 and 0271 with rated voltage being 600/1000V. All cables shall be multi stranded unless otherwise specified.

Cables directly buried in soil shall be steel wire armored (SW A) type.

Installation:**Cable in Conduit:**

Single core cables are to be installed either in metal or in PVC (water grade) conduit. The conduit size shall be as specified in the drawing. Separate conduit pipe must be used for individual discipline of supply and services cables, for example, normal power, essential power, telephone, paging, fire alarm etc. It must be ensured that cables are not scratched/ damaged during pulling. For long lengths, pull boxes must be used even if not indicated in the drawings.- Cable shall not be drawn round more than two 90 degree bends (or their equivalent) between two boxes in serial, and any single bend must not be less than 90°.

Cable in Tray and Ladder:

Cables in tray or the ladder shall be installed according to design, specification, and standard and to the satisfaction of the Project Manager. Proper spacing shall be maintained for laying cable. Cables are to be fastened with tray or ladder by appropriate and approved type fasteners.

Cable in Trench:

Unless otherwise stated in design and schedule, generally the size of the trench shall be of minimum 825mm-depth and 450 mm width for each cable to be laid. Where more than one cable is to be laid in the trench, the width of the trench is to be increased by 150mm for each extra cable for size below 70-sq. mm and 300mm for bigger size cables.

A cushion of sand (F.M 1.5), 125 mm thick is to be placed over the bed of the trench over which the cables are to be laid.

After laying the cable, first class brick on edge or flat is to be placed as separators in between the cables. After installation of the brick separators, sand filling is to be carried out up to' 150 mm from the top of the bigger cable. After sand filling, one layers of first class brick flats are to be placed

along the length and breadth of the trench as a protection against injury. The rest of the trench shall be filled with earth, watered and rammed at 150mm layers. Then red plastic sheet of 0.5mm thick shall be placed throughout the trench as an indications that power cable(s) has been laid down. After cables are laid the original ground conditions shall be restored. But if brick pavement, drain, concrete road, or bituminous carpeted road are cut across or damaged, they shall be remedied and restored to the original specification.

The cable route shall be as direct as possible and shall receive the Project Manager's approval before excavation.

Cables shall always be laid out or laid into the ground through GI pipe of suitable size as decided by the Consultant. No extra cost shall be paid for such pipes. The exposed end of the pipes shall be sealed using PVC or wooden plugs.

Cable marker of approved type shall be provided in the cable trench 300mm below GL level, along the length of laid cable.

GI cable marker shall be installed at every turning point of the trench.

After the cable is laid, it shall be tested by the Contractor in presence of the Project Manager. If the test is unsatisfactory, the cost of all repairs and replacement shall be borne by the Contractor.

All surplus earth shall be removed by the Contractor at their own cost to the indicated places.

Any damage done to any other services by the Contractor for cable laying operations shall be made good by the Contractor, at their own cost.

All chasing and passages necessary for laying of cable indoor or outdoor shall be carried out by the Contractor and the same shall be made good to the satisfaction of the Consultant by the Contractor without any extra charge to the relevant Authority.

When trenches are left open overnight, and where the road shall be cut, the Contractor shall exhibit a suitable danger signal such as banners, red flags and red lamps at his own cost. Temporary arrangement by placing wooden sleepers/steel sheet etc. across the road cutting for vehicular traffic are also to be made by the Contractor at no extra cost. The Contractor shall be wholly responsible for any accident, which may occur due to the negligence of the Contractor.

All excavations shall be filled up in layers with powdered earth and suitably watered and rammed in such a manner that after completion of the work there is no land subsidence. The road top shall be re-constructed to match the existing road pavement.

No trench shall be dug until all cables meant for laying have been procured and brought at site store. Cost of any watering or shuttering and shoring of trench required to be done shall be borne by the Contractor.

Road Crossing:

At road crossings, the cable shall be protected from damages by passing the cable through metal or concrete conduit and protecting that conduit with appropriate road construction.

Cable Termination and Joint:

There shall be no twisted joint in the entire wiring system. Cables from 2.5 sq. mm and above sizes shall be terminated through cable lugs and with spring washer, nut etc. Cable gland shall be provided for cable termination at the entrance of boxes, panels, chambers etc. For armoured cables, earth tags shall be provided with cable gland, for connection with system earth or Earth Continuity Conductor (ECC).

Cable Bending Radius**Refer item 4.1.3.1****Connection to Switches:**

The Switches or Isolators shall be provided at phase conductor only.

Cable Colour:

All cables used must have colour as stated below:

Two wire single phase A.C. system:

Red, Yellow or Blue for phase.
Black for neutral.
Green or Green-Yellow for Earth.

Three or four wire three phase A.C. system:

Red for first phase. Yellow
for second phase. Blue for
third phase. Black for
neutral.
Green or Green-Yellow for earth

Two wire D.C. system:

Red for positive or switch wire.
Black for negative.

For two wire final sub circuits.

Whether A.C. or D.C. supplying lighting or power circuits, the neutral or 'middle' wire shall always be black and the phase or outer wire (no matter which phase it is connected to) shall always be red. For lighting, the red wire shall always feed the switch, and the red wire shall always be used from the switch to the light.

Cable Identification:

All cables, all feeders or circuits in all distribution boards shall be provided with permanent and approved type of identification.

7.3.3 Earth Continuity Conductor (ECC)

7.3.3.1 Earth Continuity Conductor

Material

All ECC shall be insulated copper (BYA cable) as indicated in the schedule of items and bill of quantities. ECC shall be of white/green/green-yellow colored.

Installation

The earth continuity conductor and earthing lead shall run in accordance with the drawings and direction, and all metal fittings shall be earthed with continuity conductors. All the earth continuity conductors from various circuits, sockets, etc. shall be connected to the earthing block located within the MDB/SDB. Size of earth continuity conductors shall be as stated in the drawings. The earth continuity conductor shall be drawn along with the cables as per drawing and to the satisfaction of Project Manager and no joint shall be allowed from earthing block to the respective earth point. Light and fan points, except where indicated otherwise shall not be earthed.

7.3.3.2 Light Fitting

Material:

The light fitting shall be manufactured as per design, specification and schedule of items and BOQ and shall comply with the relevant requirements of standards, including BS 4533.

The chokes, if applicable, shall comply with the requirements of BS 2818, and shall have appropriate power factor correction capacitor (250V, 3.5 μ F for 20W and 40W tubes), the improved P.F shall not be less than 0.90. In no case power consumption by the choke shall be more than 16W for magnify ballast.

The starters shall be 2 W-I amp type and shall have built-in radio interference suppressor capacitor.

All incandescent light fittings, except where specifically stated otherwise, shall have un switched brass holders, lamp caps, complying with BS 52.

Type of lamp and detail technical data of various categories of lamps shown in design and schedule shall be followed. Appropriate sample of light fitting with choke starter and any relevant control gear shall be submitted for approval, prior to installation.

The bidder must submit detailed technical specification supported by catalogue for all light fittings, lamps, and accessories. The country of origin or manufacturer's country, brand name, model number etc. details are also to be furnished with the bid.

Any special feature, or equipment or control gear, such as photocell switch, time switch, power supply support battery, frame for installation of lamp and fixture, remote control wiring and equipment, relay etc required for any lamp, shall be inclusive of the respective light fitting item. No extra charge claimed for any of such feature or support. The entire work shall be carried out as per design, standard, schedule of works and to the satisfaction of the Project Manager.

Installation:

The light fittings shall be installed in accordance with the applicable lighting layout drawings, and to the satisfaction of Project Manager.

All pendant fittings shall be supported from brass ceiling base plate with at least 100mm screw-hub.

The location of outlets shown in the design shall be considered as approximate and it shall be the responsibility of the Contractor, before installation of outlet boxes, to study all related drawings and obtain precise information from the architectural drawing and schedule. Outlets incorrectly located and lights improperly installed, or any mal-function of any lamp shall be properly relocated or replaced by the Contractor at the Contractor's expense.

7.3.4 Lamp Post**Material:**

The G.I. pipe for lamp post shall be hot dip galvanized. The thickness of the pipe shall be as below:

Normal pipe size (mm)	Wall thickness (mm)
25	2.65
30	2.65
38	2.90
50	2.9
63	3.25
75	3.25
100	3.65
150	4.85

Installation

Fabrication, installation, testing and commissioning shall be done as per drawing, schedule and to the satisfaction of the Project Manager.

7.3.5 Ceiling Fan**Material:**

Ceiling fans shall be of capacitor type, AC 240V single phase, 50Hz, complete with suspension rod of required length, canopy and shall be constructed in accordance with applicable B.S. The minimum air velocity for 1400mm fan at horizontal distance of 600mm from the fan center and vertical distance of 1950mm shall be 47meter minute. Appropriate sample of fan shall be submitted prior to installation for approval.

Installation:

The fans shall normally be installed at a height of 2550 mm from the floor and in accordance with the applicable fan layout drawings and to the satisfaction of Project Manager. Circular box with ceiling rose for fan outlet shall be at the center of the clamps.

Fan incorrectly located or any mal-function of any fan shall be rectified or replaced by the Contractor at their own expense.

7.4 Main Distribution Board & Sub-Distribution Board (MDB/SDB)

Material

The MDB/SDB shall be as per design, specification mentioned in the schedule items and bill of quantities. Panels shall be designed for operation on a 240/415V, 50Hz, 3 phase, 4 wire system. The panels and bus bars shall have clearly marked identification.

The panels shall have printed directory on frames and on/inside of door. The door is to be provided with flush lock handle. All doors are to be keyed alike. All hinges shall be concealed. All bus bar shall be isolated by proper voltage rating insulators from board body, & front side of bus bar must have protective paints. Provision for cable entry to the DB shall be from top, bottom and sides.

The MCB/MCCB's shall be quick-make, quick-break type, and shall have inverse time limit characteristics with instantaneous magnetic trip elements functioning on overload, earth fault and short circuit. All circuit breakers shall be 'trip free'. Ratings and frame sizes of breakers shall be in accordance with design and schedule. Each breaker shall be capable of carrying rated full load current continuously without exceeding temperature rise specified in the applicable IEC standard. Circuit-breaker insulation shall be coordinated with the DB structure and shall be designed for use on 600-volt system. The MCB must comply with BS 3871 part I category M3 (5 A-60 A). Rated voltage 240/415V, A.C.50Hz, minimum interrupting capacity 6000 amp as per B.S. and capable of providing overload and short circuit protection, through thermal and magnetic trip actions respectively. Temperature rating, of CB shall be 400 C, preferably tropicalised (moisture fungus corrosion treated), with contacts of silver alloy. The MCCB must comply with BS 3871; part 2. MCCB above 25 A TP shall be adjustable type.

The MCCB's shall have the minimum symmetrical interrupting capacity as per B.S. and IEC, at 415V A.C. if not indicated otherwise:

MCB up to 63A TP or SP shall have 6 KA rating. SDC (Switch Disconnector) up to 125 A TP is 3 KA, up to 250 A TP is 4.3 KA.

The continuous current rating of individual MCB/MCCB's may be varied within + 15% at the time of installation without any additional cost implication.

Installation:

The Board shall be installed in accordance with applicable layout drawing. Minimum height to bottom of the Board from the floor level shall be 600 mm and maximum height of any circuit breaker/switch shall be 1800 mm from the same level or as specified in the drawing. The minimum depth of MDB, DB or SDB etc. shall be in accordance with schedule of items and bill of quantity.

The location of MDB/SDB shown on design shall be considered as approximate and it shall be responsibility of the Contractor before installation of MDB/SDB to study all pertinent drawings and obtain precise information from the architectural drawings. MDB/SDB incorrectly located or any malfunction of any equipment, instrument in any board shall be properly relocated or replaced by the Contractor at the Contractor's expense.

Number of outgoing circuits in different panel boards may be varied by $\pm 5\%$ at the time of installation.

7.5 Switch and Switch / Fan Regulator Board

Material:

Switch board and fan regulator board shall be as per design, specification and schedule and shall have gang switches MK England and fan regulators. The switches shall be vertical, single pole (1-way/2-way) 5A A.C., white or approved color, to BS 3676, complying with the test requirements for inductive, fluorescent or resistive loads as specified, and satisfy the test requirements of fluorescent lamp circuits, up to the ratings of these switches, as set out in BS 3676 amendment 3. The switches must have minimum clearance of 3mm between the contacts, and a similar distance. All contacts shall be faced with pure silver/silver-cadmium oxide alloy. The switch operating member shall make the speed of 'make and break' independent of the speed at which the switch is operated. Sample shall be submitted for approval prior to installation of switches.

Each board shall have copper earthing block/blocks of suitable size with necessary connecting arrangement.

Installation:

The switch board and fan regulator board shall be installed on wall at a height of 1.5 meter, if not specified otherwise, from the floor and at locations shown in applicable layout drawings. The fan regulators shall be installed inside the box with regulator knobs projected over the covering, if not specified otherwise. The phase wire shall be connected to the switches and the neutral wire shall be kept solid in all switch connections. The ECC shall be connected to the earth point inside the switch boards. Approved size steel boxes shall be installed at the time of construction of the wall to avoid chisell in wall.

The location of board shown on design shall be considered as approximate and it shall be responsibility of the Contractor, before installation switch board/regulator board boxes, to study all pertinent drawings and obtain precise information from the architectural drawings and approved shop drawings of other trades. Switch boards/regulator boards incorrectly located shall be properly relocated at the Contractor's expenses.

7.6 Socket/MCB Outlet

Material

Socket outlets shall be white in color, and conforming to B.S.546: (3 pins) and B.S. 372: part 1 (2 pins). All switched sockets shall have pure silver/silver-cadmium oxide alloy contacts in which contact pressure shall be permanently, maintained by subsidiary helical compression spring. These shall be supplied with countersunk cadmium plated fixing screws and mounted in 18 SWG (1.5 mm) hammer painted sheet steel box having brass earth point as per drawing and direction. All switch and socket outlets shall be international standard type and shall be of same manufacturer. The country of origin of switches and sockets shall be USA, UK, Germany, French or Japan.

The Controlled sockets of MCB/MCCB, if applicable, shall be un switched and the box shall have earth point.

The lift indicator outlets shall be made of 16 SWG sheet steel, [stainless steel].

Installation:

The Socket/MCB/MCCB shall be installed on wall with lower end of the face plate at a height of 225mm (Skirting level) from the floor, if not specified otherwise, and locations shown in applicable design.

The fixing of the outlets boxes shall be by means of flat head cadmium plated screws. The flat head of the screw shall be sunk in the plates so as to finish flush with the surface of the cover. The mounting height of the outlet shall be as shown in the drawing. The earth wire shall be connected to earth point of the box to the 3rd pole of the 3-pin socket.

7.7 Earthing**Material:****Earthing Electrode:****a. Pipe Electrode**

This would be 40mm dia. G.I. pipe with two 3mm dia. holes across the diameter at every 1200mm at the pipe.

b. Plate Electrode

This earth electrode shall be cold rolled double copper plate 600mmx 600mmx3mm having provision for connecting the earthing lead.

Earthing Lead:

Earthing lead shall consist of copper conductor as per specification given in 23. All terminal lugs shall be of copper and nut bolts of brass.

Earth Inspection Pit

The size of earth inspection pit shall be constructed as per drawings. The Pit cover shall be constructed by RCC slab with 10mm dia. MS rod. & having two holding hook of 20mm dia. MS rod. The designed drawing shall be submitted for the Project Manager's approval.

Installation:**Earth electrode:****a. Pipe Electrode:**

The pipe earth electrode shall be buried below ground level, as per design and schedule by tube-well sinking method. The terminal connected to the earth electrode shall use a brass clamp. After making the connection, the clamp shall be covered with bitumen poured hot and covered with jute cloth.

b. Plate Electrode:

The plate earth electrode shall be buried below ground level as per schedule and installed in an

upright position, completely surrounded by a bed of at least 300mm of charcoal and packed hard. Distance between any two-earth electrodes shall be at least 8 meter.

Earthing Lead:

The earthing lead from the earth electrode shall be connected to the earth block in MBDB etc. A double run of specified copper conductor (preferably tinned) shall be brought out of earth electrode through GI pipe and connected to the earth block. All earthing leads shall follow the shortest and most direct route to earth electrode and sharp bends shall be avoided. The earthing lead shall be made mechanically strong and electrically continuous and of minimum resistance. There shall be no joint in earthing lead conductor, between terminals.

Earth Inspection Pit

The earth inspection pit shall be constructed as per design, schedule and to the satisfaction of the Project Manager. The slab shall have level surface and the pit shall have well formed regular sides. Water curing for the slab and the pit shall be done for a minimum of 7 days.

Earth Loop Resistance test:

The maximum earth loop resistance from any point in the installation, including earthing lead to the earth electrode shall not exceed the resistance specified in the relevant standard of earth test. The Contractor must ensure that the leads are efficiently bonded to all metal works of the building other than the current carrying parts. It shall be the responsibility of the Contractor to provide earth tester, all equipment and supports, required for testing and test the installation in presence of the Consultant or authorized representative of the Authority & submit the earth test report to the relevant Authority for approval.

7.8 Service Illumination Levels

The lighting system shall be designed in accordance with the relevant standards to achieve the following levels of luminance.

Building Lighting

The following minimum luminance levels shall be provided.

Toilets	100 lux	Control
/ switchgear room	300 lux	Battery
room	200 lux	
Customer Serrviceroom	300 lux	
Stores room	200 lux	

The illumination levels at control of instrument panels shall be measured in a vertical plane at the panel location.

Emergency Lighting

An emergency lighting system shall be installed to provide the following.

Control / relay Room	50 lux
Customer Serrviceroom	50 lux
Workshop	50 lux

An emergency exit light shall be mounted above each exit/entrance.

Switchyard Lighting

The following minimum service illumination levels shall be provided;

General switchyard lighting	20 lux At
control panels and marshaling boxes	50 lux

7.9 Power Outlets

Power Outlets shall be installed in accordance with the relevant standards and according to the following tables. The actual location shall be determined during the detailed design stage with the approval of the Project Manager.

Table 1 Switchyard (New and Rehabilitated Substations)

	Amp	Nos.	
1 ø	30	6	General Area
3 ø	100	2	Transformer Area

Table 2 Building for New 10 MVA Substations

	Amp	Nos.
1 ø	10	6
	30	6
3 ø	50	1

Table 3 Building for New 5 MVA Substations and Augmented Substations

	Amp	Nos.
1 ø	10	3
	30	4
3 ø	50	1

C. MISCELLANEOUS

8.0 FIRE DETECTION & PROTECTION FACILITIES

FIRE DETECTION & PROTECTION FACILITIES

8.1 Design Requirements

All fire protection installations shall comply with the requirements of the codes of practice of the National Fire Protection Association, Boston, Massachusetts, U.S.A. as appropriate for the respective systems, subject to the approval of the Project Manager. The Codes and practice of the Japanese Fire Protection may also be considered.

8.2 Fire Detection and Alarm system

Fire detection shall be by means of smoke detectors/heat detectors with a backup system utilizing rate-of-rise temperature detectors along with alarm system. The system and its components must conform to the applicable appropriate standards. The use of these detectors shall be subject to specific approval by the Project Manager as regards their type and location.

(a) Fire Alarm Panel: 16 Zone Capacity:

Supply and Installation of 16 Zone Conventional Fire alarm control panel with power supply unit, batteries and other accessories. The panel shall be complete with zone indicating LED, Fault Indication and optional telephone Jack etc. The pane shall be input 220V AC and output 24V DC. Panel shall be confirmed UL Listed or EN54.

Country of Origin: Japan / Italy / UK / USA or equivalent approved by the Project Manager.

(b) Fire Alarm Bell:

Supply and installation of Conventional type Fire Alarm Bell of 150mm dia, red color, shall be UL / ULC / CSFM / FM / MEA / BFP / EN54 approved. Power supply shall be 24VDC. Sound level shall be not less than 92 dBA @ 3meter. Color of the Bell shall be red.

Country of Origin: Japan / Italy / UK / USA or equivalent approved by the Project Manager.

(c) Optical / Photoelectric Smoke Detector:

Supply and installation of Smoke Detector complete with base. Shall be UL / ULC / CSFM / FM / MEA / BFP / EN54 approved. Integrated alarm LED. Remote LED connection. Power supply shall be 24VDC.

Country of Origin: Japan / Italy / UK / USA or equivalent approved by the Project Manager.

(d) Heat Detector:

Supply and installation of Heat Detector complete with base. Shall be UL / ULC / CSFM / FM / MEA / BFP / EN54 approved. Integrated alarm LED. Remote LED connection. Power supply shall be 24VDC.

Country of Origin: Japan / Italy / UK / USA or equivalent approved by the Project Manager.

8.3 Fire Extinguisher

(a) Dry Chemical Powder Type:

Supply & fixing the multipurpose ABCE dry chemical powder stored pressure type with manometer system. Fire Extinguisher suitable for repeated use complete with wall bracket, discharge valve, hose pipe, easy refilling system etc. as per sample approved by the Project Manager.

Country of Origin: China / Malaysia or equivalent approved by the Project Manager.

Quantity: Two (2) portable 6 kg dry powder fire extinguishers shall be located adjacent to each power transformers.

(b) Carbon-Di-Oxide Type:

Supply & fixing the Carbon-di-Oxide type Fire Extinguisher suitable for repeated use complete with wall bracket, manometer etc. as per sample approved by the Project Manager.

Country of Origin: China / Malaysia or equivalent approved by the Project Manager.

Quantity: Two (2) portable 5 kg stored pressure carbon dioxide types shall be located inside the control room and one (1) portable 5 kg stored pressure carbon dioxide types shall be located inside the Customer Services room.

8.4 Sand Buckets

The Bucket should be wall mounted made from at least 24 SWG sheet with bracket fixing on wall conforming to NFPA Codes and Standard.

6.3 Form of Completion Certificate

Contract No:

Date:

To:

[Name of Contractor]

Pursuant to GCC Clause 42 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Procuring Entity dated *[insert date]*, for the supply and installation of plant and Services for *[name of contract]*, we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Procuring Entity hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below.

1. Description of the Facilities or part thereof: _____
2. Date of Completion: _____

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

for and on behalf of the Procuring Entity

[*Signature*]

[*Title of the Project Manager*]

6.4 Form of Operational Acceptance Certificate

Contract No:

Date:

To:

[Name of Contractor]

Pursuant to GCC Clause 43.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Procuring Entity dated *[insert date]*, for the supply and installation of plant and Services for *[name of contract]*, we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof: _____
2. Date of Operational Acceptance: _____

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

for and on behalf of the Procuring Entity

[*Signature*]

[*Title of the Project Manager*]

6.5 Form of Change Order Procedure and Forms

Contract No:

Date:

To:

[Name of Contractor]

CONTENTS

1. General
2. Change Order Log
3. References for Changes

ANNEXES

- Annex 1 Request for Change Proposal
- Annex 2 Estimate for Change Proposal
- Annex 3 Acceptance of Estimate
- Annex 4 Change Proposal
- Annex 5 Change Order
- Annex 6 Pending Agreement Change Order
- Annex 7 Application for Change Proposal

Change Order Procedure

1. General

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with GCC Clause 69 (Change in the Facilities) of the General Conditions.

2. Change Order Log

The Contractor shall keep an up-to-date Change Order Log to show the current status of Requests for Change and Changes authorized or pending, as Annex 8. Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Procuring Entity.

3. References for Changes

- (1) Request for Change as referred to in GCC Clause 69 shall be serially numbered CR-X-nnn.
- (2) Estimate for Change Proposal as referred to in GCC Clause 69 shall be serially numbered CN-X-nnn.
- (3) Acceptance of Estimate as referred to in GCC Clause 69 shall be serially numbered CA-X-nnn.
- (4) Change Proposal as referred to in GCC Clause 69 shall be serially numbered CP-X-nnn.
- (5) Change Order as referred to in GCC Clause 69 shall be serially numbered CO-X-nnn.

Note: (a) Requests for Change issued from the Procuring Entity's Home Office and the Site representatives of the Procuring Entity shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

- (b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal, Acceptance of Estimate, Change Proposal and Change Order.

Annex 1. Request for Change Proposal

(Procuring Entity's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within _____ days of the date of this letter _____.

1. Title of Change: _____

2. Change Request No. _____

3. Originator of Change: Procuring Entity: _____
Contractor (by Application for Change Proposal No. _____¹:

4. Brief Description of Change: _____

5. Facilities and/or Item No. of equipment related to the requested Change: _____

6. Reference drawings and/or technical documents for the request of Change:

<u>Drawing No./Document No.</u>	<u>Description</u>

7. Detailed conditions or special requirements on the requested Change: _____

8. General Terms and Conditions:

- (a) Please submit your estimate to us showing what effect the requested Change will have on the Contract Price.
- (b) Your estimate shall include your claim for the additional time, if any, for completion of the requested Change.
- (c) If you have any opinion negative to the adoption of the requested Change in connection with the conformability to the other provisions of the Contract or the safety of the Plant or Facilities, please inform us of your opinion in your proposal of revised provisions.
- (d) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.
- (e) You shall not proceed with the execution of the work for the requested Change until we have accepted and confirmed the amount and nature in writing.

Signature:	<i>[insert signature of authorised representative of the Procuring Entity]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Procuring Entity:	<i>[insert name of the Procuring Entity]</i>

Annex 2. Estimate for Change Proposal

(Contractor's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost of preparing the below-referenced Change Proposal in accordance with GCC Sub-Clause 69.2.1 of the General Conditions. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with GCC Sub-Clause 69.2.2, is required before estimating the cost for change work.

1. Title of Change: _____
2. Change Request No./Rev.: _____
3. Brief Description of Change: _____
4. Scheduled Impact of Change: _____
5. Cost for Preparation of Change Proposal: _____²

(a) Engineering (Amount)

(i) Engineer _____ hrs x _____ rate/hr =
(ii) Draftsperson _____ hrs x _____ rate/hr =
Sub-total _____ hrs

Total Engineering Cost

(b) Other Cost

Total Cost (a) + (b)

Signature:	<i>[insert signature of authorised representative of the Procuring Entity]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Procuring Entity:	<i>[insert name of the Procuring Entity]</i>

² Costs shall be in the currencies of the Contract.

Annex 3. Acceptance of Estimate

(Procuring Entity's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change: _____
2. Change Request No./Rev.: _____
3. Estimate for Change Proposal No./Rev.: _____
4. Acceptance of Estimate No./Rev.: _____
5. Brief Description of Change: _____
6. Other Terms and Conditions: In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparation of Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with GCC Clause 69 of the General Conditions.

Signature:	<i>[insert signature of authorised representative of the Procuring Entity]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Procuring Entity:	<i>[insert name of the Procuring Entity]</i>

Annex 4. Change Proposal

(Contractor's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

In response to your Request for Change Proposal No. _____, we hereby submit our proposal as follows:

1. Title of Change: _____
2. Change Proposal No./Rev.: _____
3. Originator of Change: Procuring Entity: / _____
Contractor: _____
4. Brief Description of Change: _____
5. Reasons for Change: _____
6. Facilities and/or Item No. of Equipment related to the requested Change:

7. Reference drawings and/or technical documents for the requested Change:

<u>Drawing/Document No.</u>	<u>Description</u>
8. Estimate of increase/decrease to the Contract Price resulting from Change Proposal:³

(Amount)

- (a) Direct material
- (b) Major construction equipment
- (c) Direct field labor (Total _____ hrs)
- (d) Subcontracts
- (e) Indirect material and labor
- (f) Site supervision

³ Costs shall be in the currencies of the Contract.

(g) Head office technical staff salaries

Process engineer	_____ hrs @ _____ rate/hr
Project engineer	_____ hrs @ _____ rate/hr
Equipment engineer	_____ hrs @ _____ rate/hr
Procurement	_____ hrs @ _____ rate/hr
Draftsperson	_____ hrs @ _____ rate/hr
Total	_____ hrs

(h) Extraordinary costs (computer, travel, etc.)

(i) Fee for general administration, _____ % of Items

(j) Taxes and customs duties

Total lump sum cost of Change Proposal
(Sum of items (a) to (j))

Cost to prepare Estimate for Change Proposal
(Amount payable if Change is not accepted)

9. Additional time for Completion required due to Change Proposal

10. Effect on the Functional Guarantees

11. Effect on the other terms and conditions of the Contract

12. Validity of this Proposal: within *[Number]* days after receipt of this Proposal by the Procuring Entity

13. Other terms and conditions of this Change Proposal:

- (a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within _____ days from your receipt of this Proposal.
- (b) The amount of any increase and/or decrease shall be taken into account in the adjustment of the Contract Price.
- (c) Contractor's cost for preparation of this Change Proposal:²

Signature:	<i>[insert signature of authorised representative of the Contractor]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Contractor:	<i>[insert name of the Contractor]</i>

² Specify where necessary.

Annex 5. Change Order

(Procuring Entity's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

We approve the Change Order for the work specified in the Change Proposal (No. _____), and agree to adjust the Contract Price, Time for Completion and/or other conditions of the Contract in accordance with GCC Clause 69 of the General Conditions.

1. Title of Change: _____
2. Change Request No./Rev.: _____
3. Change Order No./Rev.: _____
4. Originator of Change: Procuring Entity: _____
Contractor: _____
5. Authorized Price:
Ref. No.: _____ Date: _____
Foreign currency portion _____ plus Local currency portion _____
6. Adjustment of Time for Completion
None Increase _____ days Decrease _____ days
7. Other effects, if any

Authorized by: _____
(Procuring Entity)

Date:

Accepted by: _____
(Contractor)

Date:

Annex 6. Pending Agreement Change Order

(Procuring Entity's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

We instruct you to carry out the work in the Change Order detailed below in accordance with GCC Clause 64 of the General Conditions.

1. Title of Change: _____
2. Procuring Entity's Request for Change Proposal No./Rev.: _____ dated: _____
3. Contractor's Change Proposal No./Rev.: _____ dated: _____
4. Brief Description of Change: _____
5. Facilities and/or Item No. of equipment related to the requested Change: _____
6. Reference Drawings and/or technical documents for the requested Change:

<u>Drawing/Document No.</u>	<u>Description</u>
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

Signature:	<i>[insert signature of authorised representative of the Procuring Entity]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Procuring Entity:	<i>[insert name of the Procuring Entity]</i>

Annex 7. Application for Change Proposal

(Contractor's Letterhead)

To:

Date:

Attention:

Contract Name:

Contract Number:

We hereby propose that the below-mentioned work be treated as a Change in the Facilities.

1. Title of Change: _____
2. Application for Change Proposal No./Rev.: _____ dated: _____
3. Brief Description of Change: _____
4. Reasons for Change:
5. Order of Magnitude Estimation (in the currencies of the Contract):
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

Signature:	<i>[insert signature of authorised representative of the Contractor]</i>
Name:	<i>[insert full name of signatory with National ID Number]</i>
Title of the Signatory:	<i>[insert title of the Signatory]</i>
Name of the Contractor:	<i>[insert name of the Contractor]</i>

Signature

Seal

6.6 Supplementary Information

GUARANTEED TECHNICAL PARTICULARS

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For OLTC Type 20/28 MVA 33/11.55 kV, 50 Hz TRANSFORMERS

(To be filled up by the supplier with appropriate data, otherwise the Tender will be rejected)

Description	Unit	REB Requirement	Tenderers Guaranteed Values
33/11.55 kV TRANSFORMERS			
1. Manufacturer's Name			
2. Manufacturer's Address			
3. Applied Standard			
4. Type		Outdoor Oil immersed	
5. Rated Power	MVA	ONAN/ONAF 20/28 MVA	
6. Number of Phase		Three Phase	
7. Rated Voltage, Phase to Phase			
High Voltage winding	kV	33	
Low Voltage winding	kV	11.55	
8. Rated frequency	Hz	50	
9. Rated insulation level			
(a) Impulse withstand, full wave			
High voltage winding	kV	170	
Low voltage winding	kV	75	
Neutral side		Full insulation	
(b) AC withstand voltage			
High voltage winding	kV	70	
Low voltage winding	kV	28	
10. Vector Diagram (IEC 76-4)		Dyn1	
11. Type of Cooling, 20/28 MVA		ONAN/ONAF	
12. On load Tap- changer ('MR' Germany/ABB, Sweden/ Hitachi Energy, Sweden)			
Type		Required	
Rated tap	kV	33	
Tap range	%	+ 6 to -18	
Capacity	Amps	Required	
Numbers of tap	Taps	17 Nos	
Tap Step	%	1.5	
Location of tap		Primary side	
Rated short time current	kA	Required	
Oil volume	Liter	Required	
Duration of one step change	sec	Required	
Motor rating	kW	Required	
13. Impedance voltage at 75°C and at nominal ratio and 100% rated power at principal tap			
(b) 20 MVA	%	10.0% (with +10%)	

		tolerance)	
14. Temperature rise at rated power (Max. ambient temperature: 40°C)			
Oil by thermometer	deg. C.	55	
Winding by resistance measurement.	deg. C.	60	
14a. Winding hot spot temperature on emergency overload not to exceed	Deg. C	140	
14b. Maximum hot spot temperature when loaded in accordance with IEC 354	Deg. C	118	
15. System symmetrical fault level at terminal of			
33 kV	kA	31.5	
11 kV	kA	31.5	
15a. Duration of symmetrical short circuit current for which the transformer is to be designed (calculation as per IEC is to be furnished)	Sec	2	
16. Transformer core			
Type of core flux density			
At nominal voltage	Tesla	≤1.6	
17. Transformer bushings shall be from Europe/America/Japan origin			
(a) H.V. Bushing			
Voltage class		Required	
Cantilever strength		Required	
(b) L.V. Bushing			
Voltage class		Required	
Cantilever strength		Required	
(c) Neutral Bushing			
Voltage class		Required	
Cantilever strength		Required	
18. Conservator		Required	
19. Auxiliary circuit voltage for fan, etc, 3P-4W	V	415/240 AC	
20. Control Voltage	V	110 DC	
21. Sound level (IEC 551)			
ONAN (0.3m)	dB	65	
ONAF (2m)	dB	80	
22. Transformer Bushing CT			
<u>HV Side</u>			
On phase "a, b &c" (Differential)			
- Current Ratio	A	600/5	
- Rated burden	VA	20	
- Accuracy		Class X	
- Short time current	kA		
<u>LV side</u>			
On phase "a, b &c" (Differential)			

- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class X	
- Short time current	kA		
On phase "a" (OLTC)			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 5P20	
- Short time current	kA		
On phase "b" (WTI)			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 0.2	
- Short time current	kA		
Neutral Bushing for REF:			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class X	
- Short time current	kA		
Neutral Bushing CT for stand by earth fault			
- Current Ratio	A	1800/5	
- Rated burden	VA	20	
- Accuracy		Class 5P20	
- Short time current	kA		
23. Number of Cooling fan	Nos.		
24. Rating of Fan motors	kW		
25. Cooling fan losses at full ONAF capacity operation	kW		
26. Core Loss at rated frequency and rated voltage at nominal tap.	kW		
27. Copper Loss at full load, at rated frequency and 75 °C			
(i) At ONAN			
(a) At Maximum Tap	kW		
(b) At Nominal Tap	kW		
(c) At Minimum Tap	kW		
At ONAF			
(a) At Maximum Tap	kW		
(b) At Nominal Tap	kW		
(c) At Minimum Tap	kW		
28. Exciting Current at nominal tap and rated voltage	A		
29. Dimensions and Weight			
Maximum size for transport			
L x W x H	mm		
Heaviest weight for transport	Kg		
Overall height	mm		
Oil volume	Liter		

Weight of oil	Kg		
Weight of core	Kg		
Total weight	Kg		
30. Oil level indicator			
Type and model			
31. Pressure Relief Device			
Type and model			
32. Buchholz Relay			
Type and model			
Float Type		Solid Body	
Petcock is provided for testing by injecting air		Yes	
Pipe arrangement for gas release and oil collection from ground level		Yes	
Oil surge protection		Yes	
Oil drain screw provided		Yes	
33. Oil & Winding temperature indicator			
Type & model			
34. Efficiency at 75° C at unity power factor:			
e) At 28 MVA load	%		
f) At 20 MVA load	%		
g) At 15 MVA load	%		
h) At 10 MVA load	%		
35. Transformer tank	Shall be provided	Shall be high tensile steel plate	
36 .Pressure release device for both main and OLTC Tank	Shall be provided	Shall be provided	
37. Winding shall be of electrolytic copper.	Shall be provided	Shall be Electrolytic copper	
38. Pressure release device, Temperature indicating device and Buchholz relay shall be from MR Germany or Equivalent European Origin.	To be provided	Shall be from MR Germany or Equivalent European Origin.	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
33 kV SURGE ARRESTER, Station Class

(Failure to provide all of the information requested may lead to the rejection of the bid.)

SI No	Description	Unit	REB Requirement	Tenderer's Guaranteed Values
33 KV SURGE ARRESTER				
1.	Manufacturer's Name & Address		Required	
2.	Class of diverter to IEC 99-4		Heavy duty, ZnO	
3.	Rated voltage (RMS)	kV	30	
4.	Rated current	kA	10	
5.	Neutral connection		Effectively earthed	
6.	Power frequency withstand voltage of housing:			
	Dry :	kV	70 (RMS)	
	Impulse:	kV	170	
7.	Lighting impulse residual voltage	kV	100 peak	
8.	Steep current impulse residual voltage at 10 kA or 1 μ S front time	kV	110	
9.	Pressure relief device fitted?	Y/N	Required	
10.	Leakage current at rated voltage	A	Required	
11.	Minimum reset voltage	V	Required	
12.	Total creepage distance	mm	Required	
13.	Surge monitor		Required	
14.	Connecting Lead from LA terminal to surge monitor:		Shall be Insulated 16 mm ² copper cable	
15.	Overall dimension and Weight:			
	Height	mm	Required	
	Diameter	mm	Required	
	Total weight of arrester	Kg.	Required	
	Height	mm	Required	
16.	Housing material		Porcelain	
17.	MCOV	kV	22-27.5	

Seal and signature of the Manufacturer Seal and signature of the Tenderer

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
11 kV SURGE ARRESTER, Station Class

(Failure to provide all of the information requested may lead to the rejection of the bid.)

SI No	Description	Unit	REB Requirement	Tenderer's Guaranteed Values
11 kV SURGE ARRESTER				
1.	Manufacturer's Name & Address		Required	
2.	Class of diverter to IEC 99-4		Heavy duty, ZnO	
3.	Rated voltage (RMS)	kV	10	
4.	Rated current	kA	10	
5.	Neutral connection		Effectively earthed	
6.	Power frequency withstand voltage of housing:		Required	
	Dry :	kV	28(RMS)	
	Impulse:	kV	70	
7.	Lighting impulse residual voltage	kV	Required	
8.	Steep current impulse residual voltage at 10 kA or 1 μ S front time	kV	Required	
9.	Pressure relief device fitted?	Y/N	Required	
10.	Leakage current at rated voltage	A	Required	
11.	Minimum reset voltage	V	Required	
12.	Total creepage distance	mm	Required	
13.	Surge monitor		To be provided	
14.	Connecting Lead from LA terminal to surge monitor:		Shall be Insulated 16 mm ² copper cable	
15.	Overall dimension and Weight :			
	Height	mm	Required	
	Diameter	mm	Required	
	Total weight of arrester	Kg.	Required	
	Height	mm	Required	
16.	Housing material		Porcelain	
17.	MCOV	kV	8-10	

Seal and signature of the Manufacturer Seal and signature of the Tenderer

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
33/0.415 kV, 3 Phase 100 KVA STATION TRANSFORMER
(Failure to provide all of the information requested may lead to the rejection of the bid.)

Description	Unit	REB Requirement	Tenderer's Guaranteed Values
STATION SERVICE TRANSFORMERS			
19. Manufacturer's Name		Required	
20. Manufacturer's Address		Required	
21. Type		Required	
22. Applicable Standard		Required	
23. Rated power	kVA	100	
24. Rated voltage :			
- High voltage winding	kV	33	
- Low voltage winding	V	415 / 240	
25. Vector diagram		Dyn 11	
26. Rated Frequency	Hz	50	
27. Type of cooling		ONAN	
28. Type of bushing :			
- High voltage		Required	
- Low voltage		Required	
29. Off load tap-changer :			
- Rated tap	kV	33	
- Tap range	%	+ 5 to - 5	
- Number of taps	Taps	5	
30. Impedance voltage at 75deg C., at nominal ratio and rated power	%	4%±10%	
Temperature rise at rated power		Required	
(Max. ambient temp.: 40° C)		Required	
31. - Oil by thermometer	deg. C	55	
32. Winding by resistance measurement	deg. C	60	
33. Dimensions and Total Weight		Required	
34. Height x width x depth	mm	Required	
35. Total weight	Kg	Required	
36. Dimensions and Total Weight		Required	

Description	Unit	REB Requirement	Tenderer's Guaranteed Values
19. Core Loss at rated frequency and rated voltage at nominal tap.	kW	Required	
20. Copper Loss at full load, at rated frequency and at 75 °C			
(a) At Maximum Tap	kW	Required	
(b) At Nominal Tap	kW	Required	
(c) At Minimum Tap	kW	Required	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV OUTDOOR TYPE VACUUM CIRCUIT BREAKER (VCB)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

Sl. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	System voltage	kV	33	
2	Rated voltage	KV	36	
3	Rated frequency	HZ	50	
4	Rated normal current			
	Feeder	A	1250	
5	Interrupting medium		Vacuum	
6	Number of phases		3	
7	Rated short-circuit breaking current	KA	31.5	
8	Rated short-circuit making current	KA	80	
9	First pole to clear factor		1.3	
10	Rated operating sequence		O-0.3s-CO-3min-CO	
11	Rated duration of short circuit	Sec	3	
12	Impulse withstand on 1.2/50 μ s wave	KV	170	
13	Power frequency test voltage (dry) at 50Hz, 1 min	KV	70	
14	Circuit breaker operating mechanism type		Gang operated spring charged stored energy.	
15	Operating particulars			
	a) Breaking time	ms	<60ms	
	b) Closing time	ms	70 $\pm$ 10ms	
16	Is the circuit breaker trip free with anti-pumping feature?	Yes/No	Yes	
17	Trip coil voltage	VDC	110	
18	Rated supply voltage of shunt opening release	VDC	110	
19	Spring charging motor voltage	VAC	415/230	
20	Minimum clearance in air			
	a) Between phases	mm	430	
	b) Phases to earth	mm	380	
21	Degree of protection		IP 55	
22	Auxiliary Contact			
	NO	Nos	9	
	NC	Nos	9	
23	Is lockout facility fitted		Yes	
24	Rated breaking current :			
	Line charging	KA	25	

Sl. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
	Cable charging	KA	50	
	Small inductive	KA	02	
25	Installation		Outdoor	
26	Creep age Distance	mm/kv	25	
27	Closing Coil	Nos.	01	
28	Contact Resistance	$\mu\Omega$	≤ 40	
29	Is the lockout facility fitted?		Yes	
30	Length of stroke	mm	To be mentioned	
31	All current carrying parts of VCB shall be made of		Copper	
32	Tripping Coil	Nos.	02	
33	No of operation a) At rated short circuit current b) At rated current	Nos. Nos.	100 30000	
34	Standard		IEC 62271-100	
35	Manufacturer's name & Country		To be mentioned	
36	Manufacturer of vacuum bottle		Siemens/ABB or/ALSTOM	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV CONTROL and ENERGY METERING PANEL**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
1	CRP Manufacturer's Name		To be mentioned	
2	Country of Origin		To be mentioned	
3	Type of Cubicle		Simplex	
4	Degree of Protection		IP4X	
5	Dimension (W×D×H)	mm	To be mentioned	
6	Painting Quality		To be mentioned	
7	Panel Interior Color		To be mentioned	
8	Panel Exterior Color		To be mentioned	
9	Panel Base Frame Color		To be mentioned	
10	Thickness of Panel Materials	mm	To be mentioned	
11	Panel Earth Bar Thickness (W×D)	mm	To be mentioned	
12	Panel Earth Bar Material		Tinned Copper	
13	Mimic for Bus & Circuit		To be mentioned	
14	Wiring for DC Circuit		Multi Stranded 1100V Grade Flexible PVC Grey/Black 2.5 rm Wire	
15	Wiring for CT Circuit		Multi Stranded 1100V Grade Flexible PVC Insulated Red, Yellow, Blue & Black Color Wire for Phase & Neutral and should be minimum 4 rm cable	
16	Wiring for PT Circuit		Multi Stranded 1100V Grade Flexible PVC Insulated Red, Yellow, Blue & Black Color Wire for Phase & Neutral and should be minimum 2.5 rm cable	
17	Ferrule		To be Mentioned	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
For 33kV Incoming Feeder				
	PROTECTION (OVER CURRENT & EARTH FAULT RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK)/ ABB (Sweden/ Switzerland/ Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	
	b) Earth fault element of current		1% to at least 2000%	
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
4	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
5	Language		English	
6	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
7	Nominal Current	A	Operable in 1A & 5A (User Settable)	
8	Minimum No of LEDs	Nos	10 (Programmable)	
9	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
10	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
11	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
12	Standard Protocol	-	IEC 61850	

12	Protection Feature		Non-directional & Directional (if required)	
13	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
14	Standard		IEC 60255	
15	Bay control unit should have available	-	Yes	
16	Minimum No of Binary Input	Nos.	23	
17	Minimum No of Binary Output	Nos.	15	
18	IEC 61850 communication Protocol Supported		To be mentioned	
19	Sync Check function		To be mentioned	
20	U, I, P, Q, S, f, PF monitoring		Yes	
21	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
Trip Relay (Separate Relay for each Numerical Relay)				
22	Manufacturer's Name		To be mentioned	
23	Place of Manufacture		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland	
24	Manufacturer's Model Number		To be mentioned	
25	Type of Relay		To be mentioned	
26	Maximum Operating Time	ms	10	
27	Minimum No of Contact (NO + NC)	Nos	6 + 6	
28	Hand & Electrical reset mechanism		Yes	
29	Rated voltage	V DC	88-125V	
Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)				
30	Manufacturer's Name		Siemens/ABB/Alstom/GE	
31	Manufacturer's Model Number		To be mentioned	
32	Type of Relay		To be mentioned	
33	Design		Modular type	
Ampere Meters				
34	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
35	Manufacturer's Model Number		To be mentioned	
36	Type of meter		Digital	
37	Class of accuracy		0.5	
38	Separate meter for each phase		Yes	
39	Instantaneous rated current		To be mentioned	
40	ISF		Minimum 10	
Volt Meters with Selector Switch				

41	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
42	Manufacturer's Model Number		To be mentioned	
43	Type of meter		Digital	
44	Class of accuracy		0.5	
Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)				
45	Manufacturer's name & Country		Siemens (Germany/Switzerland)/Alsto m (UK)/ABB (Finland/Switzerland)/AEG (Germany)/Schlumberger (USA)/CEWE (UK/Italy)	
46	Model Number	-	To be mentioned	
47	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
48	Type of meter	-	Digital	
49	Class of accuracy	-	0.2	
50	Export & Import Metering		Export & Import	
Multi tariff programmable Energy meter (kWh Meter)				
51	Manufacturer's name & Country		Siemens (Germany/Switzerland)/Alsto m (UK)/ABB (Sweden)/AEG (Germany)/ Schlumberger (USA)/Landis Gyr (Switzerland/Greece)/CEWE (UK/Italy)	
52	Model Number	-	To be mentioned	
53	Number of kWh Meters	Nos.	1	
54	Class of accuracy	-	0.2S	
55	Installation		Indoor installation	
56	Number of element		3 (Three)	
57	Nominal Voltage	V	110	
58	Construction/connection		3-Phase 4-wire solidly grounded neutral	
59	Export & Import Metering		Export & Import	
60	Nominal Rated Current	A	Both 1A and 5A	

61	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr with an interval of 30 min, software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
62	Starting Current	mA	0.1% of Nominal Current	
63	Losses at Nominal Load			
64	a) Current Circuit	W, VA	To be mentioned	
65	b) Voltage Circuit	W, VA	To be mentioned	
66	Meter Constant	Imp./kWh	To be mentioned	
67	Integration Period		30 (Thirty) Minutes	
68	Performance Curve for Balanced & Unbalanced load		To be provided	
69	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
70	Meter Service Life (Min)	Years	15 (fifteen)	
71	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
72	Memory Storage	MB		
73	i) No of Power Interruption with Date & Time		Yes	
74	ii) Latest Power Failure- Time & Date		Yes	
75	iii) Event logs		Yes	
76	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
77	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
78	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
79	GSM-GPRS Modem		Plug and Play 4G Communication Module	
80	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			

81	Manufacturer's Name		To be mentioned	
82	Country of Origin		To be mentioned	
83	Manufacturer's Model Number		To be mentioned	
84	Windows	Nos.	Minimum 16	
85	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
	Control Switch			
86	Manufacturer's Name		To be mentioned	
87	Country of Origin		To be mentioned	
88	Manufacturer's Model Number		To be mentioned	
89	Separate Discrepancy switch for CB on/off and Local Remote (L/R) selector switch		Yes	
90	1 (One) nos. breaker Emergency trip		To be provided	
91	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
For 33/11 kV Power Transformer Incoming Feeder				
	PROTECTION (DIFFERENTIAL & REF RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK)/ ABB (Sweden/ Switzerland/ Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Main protection function		Transformer differential protection with built in low impedance REF protection feature	
4	Differential characteristics		Restrained biased characteristics with stabilization during magnetizing inrush and CT saturation	
5	CT ratio matching and vector group compensation		Internally done, software based	
6	Application		For 2 winding Transformers	
7	Tripping time		Instantaneous	
8	Restricted Earth Fault		Low impedance type	
9	Back up protection function		Instantaneous & time dependent, directional & non-directional, over current & earth fault, Over excitation & Thermal Overload Protection	
10	Display options		There must be provision of displaying restraining, differential & each phase current with angle (for both winding) on the HMI	
11	Language		English	
12	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
13	Nominal Current	A	Operable in 1A & 5A (User Settable)	
14	Harmonics blocking		2 nd and 5 th harmonics	
15	HMI		Front mounted, should be suitable to access all functions, settings and	

			stored records without external computer	
16	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
17	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
18	Standard Protocol	-	IEC 61850	
19	Minimum No of LEDs	Nos	10 (Programmable)	
20	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
21	Standard		IEC 60255	
22	Bay control unit should have available	-	Yes	
23	Minimum No of Binary Input	Nos.	13	
24	Minimum No of Binary Output	Nos.	13	
25	IEC 61850 communication Protocol Supported		To be mentioned	
26	Sync Check function		To be mentioned	
27	U, I, P, Q, S, f, PF monitoring		Yes	
28	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
PROTECTION (OVER CURRENT & EARTH FAULT RELAY)				
29	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/ UK)/ ABB (Sweden/ Switzerland/ Finland)	
30	Type of relay	-	Numerical Programmable with built-in display	
31	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	

	b) Earth fault element of current		1% to at least 2000%	
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
32	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
33	Language		English	
34	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
35	Nominal Current	A	Operable in 1A & 5A (User Settable)	
36	Minimum No of LEDs	Nos	10 (Programmable)	
37	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
38	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
39	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
40	Standard Protocol	-	IEC 61850	
41	Protection Feature		Non-directional & Directional (if required)	
42	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
43	Standard		IEC 60255	
44	Bay control unit should have available	-	Yes	
45	Minimum No of Binary Input	Nos.	23	
46	Minimum No of Binary Output	Nos.	15	
47	IEC 61850 communication Protocol Supported		To be mentioned	

48	Sync Check function		To be mentioned	
49	U, I, P, Q, S, f, PF monitoring		Yes	
50	No of Communication Ports (rear) (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned	
	Trip Relay (Separate Relay for each Numerical Relay)			
51	Manufacturer's Name		To be mentioned	
52	Place of Manufacture		UK/USA/EU/Japan/Canada /Australia/ Switzerland	
53	Manufacturer's Model Number		To be mentioned	
54	Type of Relay		To be mentioned	
55	Maximum Operating Time	ms	10	
56	Minimum No of Contact (NO + NC)	Nos	6 + 6	
57	Hand & Electrical reset mechanism		Yes	
58	Rated voltage	V DC	88-125V	
	Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)			
59	Manufacturer's Name		Siemens/ABB/Alstom/GE	
60	Manufacturer's Model Number		To be mentioned	
61	Type of Relay		To be mentioned	
62	Design		Modular type	
	Separate Auxiliary Flag Relays for Transformer self-protection (i.e., OTA, OTT, WTA, WTT, MTBA, MTBT, PRDT, OLTCBA, OLTCBT, MTMOLGA, OLTCMOLGA etc.)			
63	Manufacturer's Name		To be mentioned	
64	Place of Manufacture		UK/USA/EU/Japan/Canada /Australia/ Switzerland	
65	Manufacturer's Model Number		To be mentioned	
66	Type of Relay		To be mentioned	
67	Reset type		Hand + Electrical	
	Ampere Meters			
68	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/Alstom/ Secure/ Rishabh	
69	Manufacturer's Model Number		To be mentioned	
70	Type of meter		Digital	
71	Class of accuracy		0.5	
72	Separate meter for each phase		Yes	
73	Instantaneous rated current		To be mentioned	
74	ISF		Minimum 10	

	Volt Meters with Selector Switch			
75	Manufacturer's Name		Siemens/ABB/GE/CEWE/ Schlumberger/ AEG/ Alstom/ Rishabh	
76	Manufacturer's Model Number		To be mentioned	
77	Type of meter		Digital	
78	Class of accuracy		0.5	
	Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)			
79	Manufacturer's name & Country		Siemens (Germany/ Switzerland)/Alstom (UK)/ ABB (Finland/ Switzerland)/ AEG (Germany)/ Schlumberger (USA)/ CEWE (UK/Italy)	
80	Model Number	-	To be mentioned	
81	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
82	Type of meter	-	Digital	
83	Class of accuracy	-	0.2	
84	Export & Import Metering		Export & Import	
	Multi tariff programmable Energy meter (kWh Meter)			
85	Manufacturer's name & Country		Siemens (Germany/ Switzerland)/ Alstom (UK)/ ABB (Sweden)/ AEG (Germany)/ Schlumberger (USA)/ Landis Gyr (Switzerland/ Greece)/ CEWE (UK/Italy)	
86	Model Number	-	To be mentioned	
87	Number of KWh Meters	Nos.	1	
88	Class of accuracy	-	0.2S	
89	Installation		Indoor installation	
90	Number of element		3 (Three)	
91	Nominal Voltage	V	110	
92	Construction/connection		3-Phase 4-wire solidly grounded neutral	
93	Export & Import Metering		Export & Import	
94	Nominal Rated Current	A	Both 1A and 5A	
95	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr	

			with an interval of 30 min, software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
96	Starting Current	mA	0.1% of Nominal Current	
97	Losses at Nominal Load			
	a) Current Circuit	W, VA	To be mentioned	
	b) Voltage Circuit	W, VA	To be mentioned	
98	Meter Constant	Imp./kWh	To be mentioned	
99	Integration Period		30 (Thirty) Minutes	
100	Performance Curve for Balanced & Unbalanced load		To be provided	
101	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
102	Meter Service Life (Min)	Years	15 (fifteen)	
103	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
104	Memory Storage	MB		
105	i) No of Power Interruption with Date & Time		Yes	
106	ii) Latest Power Failure- Time & Date		Yes	
107	iii) Event logs		Yes	
108	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
109	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
110	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
111	GSM-GPRS Modem		Plug and Play 4G Communication Module	
112	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			
113	Manufacturer's Name		To be mentioned	
114	Country of Origin		To be mentioned	

115	Manufacturer's Model Number		To be mentioned	
116	Windows	Nos.	Minimum 28	
117	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
	Control Switch			
118	Manufacturer's Name		To be mentioned	
119	Country of Origin		To be mentioned	
120	Manufacturer's Model Number		To be mentioned	
121	Separate Discrepancy switch for CB on/off and Local Remote (L/R) selector switch		Yes	
122	1 (One) nos. breaker Emergency trip		To be provided	
123	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33KV CURRENT TRANSFORMER (CT)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)
Failure to provide all of the information requested may lead to the rejection of the bid.

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	Type		Electromagnetic induction, single phase, oil immersed outdoor	
2	Rated primary current			
	For incoming feeder	Amps	1600-800A	
	For outgoing and transformer feeder	Amps	800-400A	
3	Rated secondary current			
	For incoming, outgoing and transformer feeder	Amps	5-5-5A	
	For spare	Amps	1-1-1A	
4	Rated secondary accuracy and burden (33 kV incoming feeder & outgoing feeder & Spare)			
	a) Protection (core 1)		5P20, 30VA	
	b) Metering (core 2- dedicated for energy metering)		0.2S, 30VA	
	c) Metering(core 3- for indicating meters)		0.2S, 30VA	
	Rated secondary accuracy and burden (33 kV transformer feeder)			
	a) Protection (core 1 & 2)		5P20, 30VA	
	b) Metering (core 3- for energy meters and indicating meters)		0.2S, 30VA	
5	Rated frequency	Hz	50	
6	System voltage	kV	33	
7	Rated voltage for equipment	kV	36	
8	Short time current rating for 3 sec.	kA	31.5	
9	Extended current rating (% of rated current)	%	120	
10	Basic insulation level on 1.2 / 50 micro-sec wave	kV	170	
11	Power frequency withstand voltage (1 min, 50 Hz)	kV	70	
12	Creep age distance	mm/kv	25	
13	Bushing		Porcelain outdoor type	
14	System earthing		Effectively earthed	

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
15	Insulation class		A	
16	Standard		IEC60044-1	
17	Knee point voltage for protection (at both ratio):		The value should be sufficient to meet 5P20 at rated burden and measured CT secondary resistance.	
18	Knee point voltage for metering (at both ratio):		The value should be sufficient to meet FS<5	
19	Security factor, (FS for the metering core)		<5	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE**FOR 33 KV VOLTAGE TRANSFORMER (VT FOR BUS & FEEDERS)**

(To be filled up by the bidder with appropriate data, otherwise the Bid will be rejected)

Failure to provide all of the information requested may lead to the rejection of the bid.

SL. No.	Description	Unit	REB Requirements	Tenderer's Guaranteed Values
1	Type		Electromagnetic induction, single phase, outdoor	
2	Rated primary voltage	kV	33/ $\sqrt{3}$	
3	Rated voltage for secondary windings	kV	0.11 / $\sqrt{3}$ and 0.11 / $\sqrt{3}$	
4	Rated secondary burden and accuracy			
	Secondary winding Core 1 (metering)	VA Class	50VA 0.2	
	Secondary winding Core 2	VA Class	50VA 3P	
5	Frequency	Hz	50	
6	Impulse withstand voltage (1.2/50 micro sec wave)	kV	170	
7	Cree page distance	mm/kV	25	
8	System earthing		Effectively earthed	
9	Power frequency withstand voltage (1min)	KV	70	
10	Partial discharge	PC	≤ 5	
12	Rated voltage factor		1.2 continuous 1.9 at 30 second	
13	Standard		IEC 60044-2	
14	Short time current rating for 3 sec.	kA	31.5	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
FOR 33 KV ISOLATOR/EARTH SWITCH**

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

Description		Unit	BREB/PBS Requirement	Tenderer's Guaranteed Values
1.	Name of the manufacturer		Required	
2.	Switch Type & Model		Required	
3.	Rated Voltage & Frequency	KV/ H z	33,50	
4.	Maximum Continuous voltage	KV	36	
5.	Rated Current c) For feeder d) For bus section	A A	1250 2500	
6.	Rated Short time current (3 sec)	KA	31.5	
7.	Impulse withstand voltage	KV	170	
8.	Power Frequency withstand voltage (1 min)	KV	70	
9.	Creepage Distance	mm	Required	
10.	Dimension of the supporting steel structure		Required	
	Height	mm	Required	
	Width	Mm	Required	
	Length		Required	
11.	Weight of the phase units	Kg	Required	
12.	Phase center distance	Mm	Required	
13.	Period of time, equipment has been in service	Years	2	
14.	Period of time, equipment has been in manufacture	Years	5	
15.	Earth Switch		Required	
16.	Manufacturer		Required	
17.	Country of Manufacture		Required	
18.	Manufacturer type designation		Required	
19.	Reference Standard		Required	
20.	Number of years disconnector type in service		Required	
21.	Nominal system Voltage	KV	33	
22.	Highest system voltage	KV	36	
23.	Frequency	Hz	50	
24.	Rated Current	A	1250/2500	
25.	Type of operating mechanism		Hand	
26.	Contact resistance	μ	≤ 40	

Seal and Signature of the Manufacturer

Seal and Signature of the Bidder

TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE

11 KV SWITCHGEAR AND CONTROL EQUIPMENT

(to be filled up by the manufacturer with appropriated data, otherwise the Tender will be rejected)

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
1	Manufacturer's Name & Address		To be mentioned	
2	Applied standard		To be mentioned	
3	Rated nominal voltage	kV	11	
4	Rated Voltage	kV	12	
5	Rated current for bus	A	2500	
6	Rated short time current	kA	31.5	
7	Short time current rated duration	Sec.	03	
8	Type		VCB	
9	Vacuum Interrupter Manufacturer		ABB/ Siemens or Alstom	
INCOMING FEEDER SWITCHGEAR UNITS				
Circuit Breaker:				
10	Rated Voltage	kV	12	
11	Rated Current	A	2000	
12	Rated short Ckt. Breaking current, 3 Sec.	kA	31.5	
13	Rated short Ckt. Making current	kA	80	
14	First pole to clear factor	1.5		
15	Rated breaking time	Cycle	< 3	
16	Opening time	ms	≤ 60	
17	Closing time	ms	≤ 70	
18	Contact resistance	μΩ	< 40	
19	No of Operation a) At Rated short circuit current b) At rated current	Nos Nos	100 30000	
20	Rated operating sequence	0-0.3 sec-CO-3 min-CO		
21	Control voltage	V	DC 110	
22	Motor voltage for spring charge	V	AC 180-240	
23	No. of Trip coil	No.	02	
Current Transformer:				
24	Rated Voltage	kV	12	
25	Accuracy class, Metering	0.2S		
26	Accuracy class, Protection	5P20		
27	Accuracy class, Protection	5P20		
28	Rated current ratio	A	2000-1000:5-5-5	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
29	Factor of security	≤ 5		
30	Burden (At both ratio)	VA	20	
31	Rated frequency	Hz	50	
	Insulation level			
32	AC withstand voltage 1 min. dry	kV	28	
33	Impulse withstands, full wave	kV	75	
	Degree of Protection			
34	Enclosure	IP4X		
35	HV Compartment	IP65		
36	LV Compartment	IP40		
	Bus bar			
37	Material		Copper	
38	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
39	Height	mm	To be mentioned	
40	Width	mm	To be mentioned	
41	Depth	mm	To be mentioned	
42	Weight including Circuit Breaker	Kg.	To be mentioned	
	Voltage Transformer			
43	Number of phases		To be mentioned	
44	Rated primary voltage	kV	11/√3	
45	Rated secondary voltage	V	110/√3	
46	Rated burden (both Metering & Protection)	VA	50	
47	Accuracy class for metering		0.2	
48	Accuracy class for protection		3P	
	Power Fuse			
49	Rated voltage	kV	12	
50	Rated current	A	To be mentioned	
51	Rated short Ckt. breaking current, 3 Sec.	kA	31.5	
	BUS SECTIONALIZER SWITCHGEAR UNIT WITH RISER			
	Circuit Breaker:			
52	Rated Voltage	kV	12	
53	Rated Current	A	2000	
54	Rated short Ckt. breaking current, 3 Sec.	kA	31.5	
55	Rated short Ckt. making current	kA	80	
56	First pole to clear factor		1.5	
57	Rated breaking time	Cycle	< 3	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
58	Opening time	ms	≤ 60	
59	Closing time	ms	≤ 70	
60	Contact resistance	μΩ	< 40	
61	No of Operation At Rated short circuit current b) At rated current	Nos Nos	100 30000	
62	Rated operating sequence		0-0.3 sec-CO-3 min-CO	
63	Control voltage	V	DC 110	
64	Motor voltage for spring charge	V	AC 180-240	
65	No. of Trip coil	No.	02	
	Current Transformer:			
66	Rated Voltage	kV	12	
67	Accuracy class, Protection		5P20	
68	Accuracy class, Metering		0.2S	
69	Rated current ratio	A	2000-1000:5-5	
70	Factor of security	≤ 5		
71	Burden (At both ratio)	VA	20	
72	Rated frequency	Hz	50	
	Insulation level:			
73	AC withstand voltage 1 min. dry	kV	28	
74	Impulse withstands, full wave	kV	75	
	Degree of Protection			
75	Enclosure		IP4X	
76	HV Compartment		IP65	
77	LV Compartment		IP40	
	Earthing Switch:			
78	Type		To be mentioned	
79	Short Time Current, 3Secs.	kA	31.5	
	Busbar:			
80	Material		Copper	
81	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
82	Height	mm	To be mentioned	
83	Width	mm	To be mentioned	
84	Depth	mm	To be mentioned	
85	Weight including Circuit Breaker	kg.	To be mentioned	
86	Type	To be mentioned		
	Busbar:			
87	Material	Copper		

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
88	Cross Section	mm ²	To be mentioned	
89	Rated nominal voltage	kV	11	
90	Rated Voltage	kV	12	
91	Rated current for bus	A	2500	
92	Rated short time current	kA	31.5	
93	Short time current rated duration	Sec.	3	
	LINE FEEDER SWITCHGEAR UNITS			
	Circuit Breaker:			
94	Rated Voltage	kV	12	
95	Rated Current	A	630	
96	Rated short Ckt. Breaking current, 3 Sec.	kA	31.5	
97	Rated short Ckt. Making current	kA	80	
98	First pole to clear factor		1.5	
99	Rated breaking time	Cycle	< 3	
100	Opening time	ms	≤ 60	
101	Closing time	ms	≤ 70	
102	Contact resistance	μΩ	< 40	
103	No of Operation a) At Rated short circuit current b) At rated current	Nos Nos	100 30000	
104	Rated operating sequence		0-0.3 sec-CO-3 min-CO	
105	Control voltage	V	DC 110	
106	Motor voltage for spring charge	V	AC 180-240	
107	No. of Trip coil	No.	02	
	Current Transformer:			
108	Rated Voltage	kV	12	
109	Accuracy class, Metering		0.2S	
110	Accuracy class, Protection		5P20	
111	Rated current ratio	A	600-300:5-5	
112	Factor of security	≤ 5		
113	Burden (At both ratio)	VA	20	
114	Rated frequency	Hz	50	
	Insulation level			
115	AC withstand voltage 1 min. dry	kV	28	
116	Impulse withstands, full wave	kV	75	
	Degree of Protection			
117	Enclosure	IP4X		

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
118	HV Compartment	IP65		
119	LV Compartment	IP40		
	Bus bar			
120	Material		Copper	
121	Cross Section	mm ²	To be mentioned	
	Dimension and Weight			
122	Height	mm	To be mentioned	
123	Width	mm	To be mentioned	
124	Depth	mm	To be mentioned	
125	Weight including Circuit Breaker	Kg.	To be mentioned	
	Voltage Transformer			
126	Number of phases		To be mentioned	
127	Rated primary voltage	kV	11/√3	
128	Rated secondary voltage	V	110/√3	
129	Rated burden (both Metering & Protection)	VA	50	
130	Accuracy class for metering		0.2	
131	Accuracy class for protection		3P	
	Power Fuse:			
132	Rated voltage	kV	12	
133	Rated current	A	To be mentioned	
134	Rated short Ckt. breaking current	kA	31.5	
	Dimension and Weight			
135	Height	mm	To be mentioned	
136	Width	mm	To be mentioned	
137	Depth	mm	To be mentioned	
138	Weight including Circuit Breaker	kg.	To be mentioned	
	Degree of Protection			
139	Enclosure		IP4X	
140	HV Compartment		IP65	
141	LV Compartment		IP40	
142	Insulation Level	kV	To be mentioned	
143	All current carrying path must be copper.			

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
	11 kV CONTROL RELAY AND ENERGY METERING PANEL			
	PROTECTION (OVER CURRENT & EARTH FAULT RELAY)			
1	Manufacturer's Name & Country	-	Siemens (Germany)/ GE (USA/UK) ABB (Sweden/Switzerland/Finland)	
2	Type of relay	-	Numerical Programmable with built-in display	
3	Range setting			
	a) Phase element of current	% of CT rating	5% to at least 2000%	
	b) Earth fault element of current		1% to at least 2000%	
	c) Time Multiplier Setting (TMS)		0.025 to at least 1.5 (Step Size 0.005)	
4	Ranges of timing at DMT	Sec	0-100 (with 1ms interval)	
5	Language		English	
6	Relay Auxiliary Voltage	V	Minimum 88-250V DC and Minimum 115-250V AC	
7	Nominal Current	A	Operable in 1A & 5A (User Settable)	
8	Minimum No of LEDs	Nos	10 (Programmable)	
9	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
10	Software Requirement		a) Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. b) Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license with probe/cable.	
11	Event Record & Oscillographic Disturbance Records		Event recorder should keep at least 20 Nos previous records and disturbance recorder should handle all analogue channels and binary channels	
12	Standard Protocol	-	IEC 61850	
13	Protection Feature	-	Non-directional & Directional (for Incomer)	
14	Test Terminal Block (TTB) for OC & EF Relay (incl. male and female part)		Yes	
15	Standard		IEC 60255	
16	Bay control unit should have		Yes	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
	available			
17	IEC 61850 communication Protocol Supported		To be mentioned	
18	Sync Check function		To be mentioned	
19	U, I, P, Q, S, f, PF monitoring		Yes	
20	No of Communication Ports (rear) i) Optical ii) Electrical (Minimum 1 Optical Ports with redundancy must be provided)		To be mentioned To be mentioned	
21	Minimum Number of Binary Input		16 nos	
22	Minimum Number of Binary Output		10 nos	
	Trip Relay (Separate Relay for each Numerical Relay)			
23	Manufacturer's Name		To be mentioned	
24	Place of Manufacture		UK/USA/EU/Japan/Canada/Australia/Switzerland	
25	Manufacturer's Model Number		To be mentioned	
26	Type of Relay		To be mentioned	
27	Maximum Operating Time	ms	10	
28	Minimum No of Contact (NO + NC)	Nos	6 + 6	
29	Hand & Electrical reset mechanism		Yes	
30	Rated voltage	V DC	88-125V	
	Trip Circuit Supervision (TCS) Relay (Separate Relay for each trip coil)			
31	Manufacturer's Name		Siemens/ABB/Alstom/GE	
32	Manufacturer's Model Number		To be mentioned	
33	Type of Relay		To be mentioned	
34	Design		Modular type	
	Ampere Meters			
35	Manufacturer's Name		Siemens/ ABB/ GE/ CEWE/ Schlumberger/ AEG/ Alstom/ Secure/ Rishabh	
36	Manufacturer's Model Number		To be mentioned	
37	Type of meter		Digital	
38	Class of accuracy		0.5	
39	Separate meter for each phase		Yes	
40	Instantaneous rated current		To be mentioned	
41	ISF		Minimum 10	
	Volt Meters with Selector Switch			
42	Manufacturer's Name		Siemens/ABB/GE/CEWE/Schlumberger/ AEG/Alstom/ Secure/ Rishabh	
43	Manufacturer's Model Number		To be mentioned	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
44	Type of meter		Digital	
45	Class of accuracy		0.5	
	Multifunction Meter (kW, kWh, kVARh, Voltage, Current, PF, Frequency)			
46	Manufacturer's name & Country		Siemens (Germany /Switzerland) / Alstom (UK)/ ABB (Finland/ Switzerland) /AEG (Germany)/ Schlumberger (USA)/ CEWE (UK/Italy)	
47	Model Number	-	To be mentioned	
48	Number of Meters	Nos.	Multifunction meter containing (Ammeter, voltmeter, kW meter, kVAR meter, PF meter, frequency meter)	
49	Type of meter	-	Digital	
50	Class of accuracy	-	0.2	
51	Export & Import Metering		Export & Import	
	Multi tariff programmable Energy meter (kWh Meter)			
52	Manufacturer's name & Country		Siemens (Germany/Switzerland)/ Alstom (UK)/ ABB (Sweden)/ AEG (Germany)/ Schlumberger (USA)/ Landis Gyr (Switzerland/Greece)/ CEWE (UK/Italy)	
53	Model Number	-	To be mentioned	
54	Number of KWh Meters	Nos.	1	
55	Class of accuracy	-	0.2S	
56	Installation		Indoor installation	
57	Number of element		3 (Three)	
58	Nominal Voltage	V	110	
59	Construction/connection		3-Phase 4-wire solidly grounded neutral	
60	Export & Import Metering		Export & Import	
61	Nominal Rated Current	A	Both 1A and 5A	
62	Type of the meter		Numerical Programmable, Multifunction with accuracy Class 0.2S, Load profile, instrumentation profile for minimum 1 yr with an interval of 30 min, software for protection and optical probe for data download as per IEC with provision of communication port automatic meter reading (AMR).	
63	Starting Current	mA	0.1% of Nominal Current	
64	Losses at Nominal Load			
	a) Current Circuit	W, VA	To be mentioned	
	b) Voltage Circuit	W,	To be mentioned	

Sl. No.	Description	Unit	BREB's Requirement	Tenderer's Guaranteed Values
		VA		
65	Meter Constant	Imp./ kWh	To be mentioned	
66	Integration Period		30 (Thirty) Minutes	
67	Performance Curve for Balanced & Unbalanced load		To be provided	
68	Battery Service life and shelf Life (minimum)	Years	10 (ten) & 15 (fifteen)	
69	Meter Service Life (Min)	Years	15 (fifteen)	
70	Meter sealing condition		Hermetically or Ultrasonic welded (means break to open)	
71	Memory Storage		MB	
72	i) No of Power Interruption with Date & Time		Yes	
73	ii) Latest Power Failure- Time & Date		Yes	
74	iii) Event logs		Yes	
75	iv) Cumulative kWh, kVARh (Q1 + Q4) Reading for previous two months		Yes	
76	v) Load profile with 30 min interval at least 01 (One) year for:			
	a) kWh, kVARh (Q1+Q4)		Yes	
	b) Phase Voltage or Vh		Yes	
	c) Phase Amps or Ah		Yes	
77	Communication Facilities		RS 232, RS 485, RJ45, GSM-GPRS and Modbus or IEC 61850	
78	GSM-GPRS Modem		Plug and Play 4G Communication Module	
79	Optical Probe & TTB(incl. male & female part)		To be provided	
	Annunciator			
80	Manufacturer's Name		To be mentioned	
81	Country of Origin		To be mentioned	
82	Manufacturer's Model Number		To be mentioned	
83	Windows	Nos.	Minimum 12	
84	Built in buzzer and buttons for accept, mute, test, reset, etc.		Yes	
85	Mounting of Relays and Meters		All Relay and Meter shall be flush mounted	

Seal and signature of the Manufacturer

Seal and signature of the Tenderer

Technical Requirement for Substation Automation System

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Name & address of the Manufacturer	-	To be mentioned	
Country of Origin and Manufacture (Shall be the same)	-	USA/UK/EU/Japan/ Canada/ Switzerland	
General Requirement:			
Communication protocol at all levels	-	IEC61850. Fully complying with the standard.	
Temperature range (min/max) Computer	° C	0 to 50	
Relative humidity	%	20 to 93 non- condensing	
System performance, interoperability and interchangeability test among ABB (Switzerland/Sweden/Finland)/ Hitachi (Switzerland/Sweden)/Siemens (Germany)/ Alstom (France/UK) and SEL(USA) IEDs done in the system verification center.	-	Yes	
All updated SCD, ICD and CID files shall be provided in portable hard drives and CD/DVD	-	YES	
Detailed Requirements			
Manufacturer of the Automation Panel		To be mentioned	
Country of Origin of the Automation Panel		USA/UK/EU/Japan/ Canada/ Switzerland	
The Automation Panel shall be from the origin of the manufacturer of the system	-	Yes	
Name of the Substation Automation System Software	-	To be mentioned	
Name and Address of the Substation Automation System Software manufacturer	-	To be mentioned	
Engineering and Assembling of the substation automation system shall be from the origin of the system		Yes	
Automation equipment Manufacturer's experience	Year	10	
Number of years of proven field experience of offered system. (Note: proof of experience should be furnished. The components used in the offered system and those with field experience should be the same)	Year	5	

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Model of the Substation Automation System		To be mentioned	
Design life of Substation Automation System	Year	≥ 20	
Manufacturers quality assurance system	-	ISO 9001/9002 or equivalent	
Dimensions of cubicle	mm	To be mentioned	
Floor load	N/m ²	max. 600	
Station Level Equipment:			
Station Computer	-	Industrial PC (From Internationally Reputed Manufacturer)	
Power supply to the servers	-	230V AC from Inverter	
Operating System	-	Windows	
All standard picture as per Tspec included in HMI	-	To be provided	
Process Status Procedures	-	To be provided	
Event processing as per Tsp Ec	-	To be provided	
Alarm processing as per Tspec	-	To be provided	
Trend Display as per Tspec	-	To be provided	
User Authority levels as per spec	-	To be provided	
System supervision & monitoring as per Tspec	-	To be provided	
Automatic sequence control as per Tspec	-	To be provided	
High quality SCD file complete with ICD files& station topology	-	To be provided	
Operator Work Station (Master/Backup workstation) shall have separately connection o different Ethernet switch		Yes	
MTBF (Mean time between Failures)	Hrs.	Shall be mentioned	
MTTR (Mean time to repair)	Hrs.	Shall be mentioned	
Dual Station Computers Provided in redundant hot standby configuration		YES	
Number of years of proven field experience of offered software	Yrs.	5	
Gateway to Central Control Room			
Name of manufacturer, Address & Country of origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Model no.	-	To be provided	
Number of years of proven field experience of offered unit	Year	5	
Insulation tests	-	As per IEC60255-5	

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Fast disturbance tests	-	IEC 61000-4-4, Calss 4	
Industrial environment	-	EN50081-2ClassA	
Industrial grade hardware with no moving parts (PC-based gateway is not accepted)	-	To be provided	
Design life of offered equipment	Year	20	
Redundant communication channel	-	To be provided	
Redundant CPU	-	To be provided	
Redundant DC/DC Supply	-	To be provided	
MTBF (Mean time between Failures)	Hrs	To be mentioned	
MTTR (Mean time to repair)	Hrs	To be mentioned	
Station Bus:			
Connection between Ethernet switches		Glass fiber optic	
Connection between Ethernet switches and IPC, Gateway, Firewall, Printer etc.		Ethernet	
Inter bay Bus			
Physical Medium		Glass fiber optic	
Event Printer			
MTBF	Hrs	To be mentioned	
Hard Copy Colour Printer			
MTBF	Hrs	To be mentioned	
Master Clock GPS (Global Positioning System) Receiver:			
Name of the manufacturer & country of origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Manufacturer's address	-	To be mentioned	
Model		Shall be mentioned	
MTBF	Hrs.	Shall be mentioned	
Ethernet Switch			
Name of manufacturer &. address	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Model number	-	To be mentioned	
Type		Industrial Grade, rackmount	
Redundant Power supply	-	To be provided	
Ethernet switch shall have dual connection to each other.		Yes	
Communication Port		Optical with LC connector & Ethernet (Must be compatible with IED Communication Port)	
Operator Work Station (OWS)			

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Type	-	Industrial PC	
Country of Manufacture	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Processor	GHz	Intel core i7/ Core Ultra 7 13th generation or latest generation	
Clock Speed	GHz	3.0 GHz (min), 30 MB Cache Memory (min)	
Bus Speed	MHz	Min. 3200 MHz or higher	
RAM	GB	16 GB, Expandable to 32 GB (min.)	
HDD	TB	2 x 1 TB NVMe SSD (RAID)	
OS	-	Licensed windows with Software recovery kit	
Software	-	Lifetime Licensed Anti-Virus Software	
Mouse	-	Reputed Brand Wireless Optical Mouse	
Keyboard	-	Integrated standard Keyboard	
Monitor	inch	15.6", Full HD (min)	
Engineer Work Station (EWS)			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of Origin	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Processor	GHz	Intel Core i5 Processor, 13th generation or latest	
Clock Speed	GHz	3.0 GHz (min), 20 MB Cache Memory (min)	
Bus Speed	MHz	Min. 3200 MHz or higher	
RAM	GB	16 GB DDR4	
HDD	GB	1 TB NVMe SSD	
Mouse	-	Reputed Brand Wireless Optical Mouse	
Keyboard	-	Integrated standard Keyboard	
Monitor	inch	15.6", Full HD (min)	
OS Support	-	Windows 11 professional or latest	
OS	-	License windows with recovery kit	

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Software	-	All types of configuration software with licenses for SAS and IED, Licensed Anti-Virus Software, Licensed OS & other necessary software	
Laser Color Printer			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of origin	-	To be mentioned	
Toner type	-	Toner and associated drum unit in single case, No starter toner. output tray, 250-sheet facedown output tray purpose	
Media Sizes	-	Letter, Legal, A4, A5, B5 and custom sizes	
Media Types	-	Paper (Plain, Preprinted, Letterhead, Bond, Paper (Plain Color, Recycled, Rough), Transparencies, Labels	
Event Printer			
Brand	-	Any International reputed brand.	
Model	-	To be mentioned	
Country of origin	-	To be mentioned	
Print Method	Pin	9 Pin Serial Impact Dot Matrix.	
Print Speed	Lps	Min. 6.0 LPS (30 Columns:16 CPI).	
Data Buffer	KB	4KB.	
Inked Ribbon	-	ERC-38(Black/Red).	
Interface	-	USB Interface, Bi- directional parallel.	
System Performance:			
Exchange of display (First reaction)	Sec	<1	
Presentation of a binary change in the Process display	Sec	< 0.5	
Presentation of an analogue change in the process display	Sec	<1	
From order to process output	Sec	< 0.5	
From order to updated of display	Sec	< 1.5	
Protocol Converter / IO module, if required			
Brand	-	To be mentioned	
Model	-	To be mentioned	
Country of Manufacturer	-	USA/UK/EU/Japan/ Canada/ Switzerland	
Detail Signaling & Interlocking system		To be included	

DESCRIPTION	Unit	BREB's Requirement	Tenderers guaranteed values
Firewall			
Name of Manufacturer		To be mentioned	
Brand		To be mentioned	
Model/Type		To be mentioned	
Origin		USA/UK/EU/Japan/ Canada/ Switzerland	
IP Filtering Port Filtering MAC Filtering Port Forwarding DMZ Denial of Service NAT Mapping		To be provided	
Packet throughput of at least 150 Mbps		To be mentioned	
3DES Encryption throughput of 20 Mbps		To be mentioned	
Support for 200 VPNs		To be mentioned	
Maximum concurrent sessions, with AVC		To be mentioned	
Maximum new connections per second, with AVC		To be mentioned	
Local On-device Management		Yes	
Application Visibility and Control (AVC)		Standard	
Security Intelligence		Standard, with IP, URL, and DNS threat intelligence	
List (Name & version) of all types of software required for SAS configuration, operation, monitoring and Remote control individually for Both OWS and EWS		To be mentioned	
Others Requirement			
All Licenses required for the system including future SCADA connection with physical communication port ready installed		To be provided as per requirement of employer	
The Communication device shall support for future SCADA connection		IEC 60870-5-104	
Facility for measuring SAIDI SAIFI		To be included	
The licence provided for all kind of software related to SAS must be lifetime duration.			

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**TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
DEMO SUBSTATION AUTOMATION SYSTEM**

SI No	Parameter	Required Specification	Tenderers Guaranteed Values
1	Manufacturer Name & Address	To be mentioned	
2	Model Name	To be mentioned	
	Protection Relay (IED)		
3	Type	Numerical Multifunction Relay	
4	Manufacturer's Name & Country	ABB (Finland)/ Siemens (Germany)/ GE (USA/ UK)	
5	Model	To be mentioned	
6	Communication Protocol	IEC 61850	
	Bay Control Unit (BCU)		
7	Manufacturer's Name & Country	ABB (Finland)/ Siemens (Germany)/ GE (USA/ UK)	
8	Model	To be mentioned	
9	Communication	IEC 61850 Compatible	
	SCADA / HMI Workstation		
10	Software Compatibility	IEC 61850 Client	
11	Functions	SLD, Alarm, Event Log, Data Logging	
12	Report Generation	Required	
13	List of licensed Software and model	To be mentioned	
	CT/VT Simulator		
14	Fault Simulation	Phase & Earth Fault	
15	Remote Terminal Unit (RTU)		
16	Type	Industrial RTU/Gateway	
17	IEC 61850 Support	Client	
18	IEC 60870-5-104	Server	
19	DNP3	Optional	
	Master Trip Relay		
20	Manufacturer's Name and Country	To be mentioned	
21	Model	To be mentioned	
	Multifunction Meter		
22	Manufacturer's Name and Country	To be mentioned	
23	Model	To be mentioned	
	RTU		
24	Manufacturer's Name & Country	To be mentioned	
25	Model	To be mentioned	
26	In-built Firewall Functionality	To be provided	

SI No	Parameter	Required Specification	Tenderers Guaranteed Values
	Laptop		
27	Manufacturer Name	To be mentioned	
	Monitor		
28	Manufacturer Name	To be mentioned	
	Demo Panel		
29	Mimic Diagram	Required	
30	Wiring	Ferruled & Tagged	

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TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For Battery and Battery Charger

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

Sl. No.	Description	Unit	Requirement	Tenderer's Guaranteed Data
A.	BATTERY			
1	Manufacturer		To be mentioned	
2	Model no		To be mentioned	
3	Electrolyte		Nickel Cadmium Alkaline	
4	Installation		Indoor	
5	Operating voltage	V DC	110	
6	Continuous Discharge Current at rate of 10 hour & Final Cell Voltage 1.1 Volt.	Amp	25	
7	Charging Voltage (Maximum)	Volt	1.54-1.70 Per Cell	
8	Normal float charge rate	A	To be mentioned	
9	Maximum boost charge rate	A	To be mentioned	
10	Voltage per cell	V/ cell	1.2	
11	Capacity at 10 hour rate	Ah	250	
12	Number of cells	Nos	92	
13	Float voltage per cell	V/ cell	1.4-1.42	
14	Discharge voltage	V/ cell	1.1-1.7	
	Battery voltage at end of the duty cycle	V	1.1V per cell	
15	Maximum charging rate	A	50	
16	Ampere-hour efficiency at ten hour rate	%	To be mentioned	
17	Ampere-hour efficiency at one hour rate	%	To be mentioned	
18	Dimensions of cells	mm	To be mentioned	
19	Weight of cell complete with electrolyte	kg	To be mentioned	
20	Internal resistance per cell when fully charged	ohms	To be mentioned	
22	Material of battery case		To be mentioned	
23	Standard		IEC 623	
B.	CHARGER			
1	Manufacturer		To be mentioned	
2	Model No		To be mentioned	
3	Rectifier Type		Thyristor	
4	AC input voltage	V	415±15%	
5	Input AC frequency	HZ	50±5%	
6	DC Output voltage			

Sl. No.	Description	Unit	Requirement	Tenderer's Guaranteed Data
7	a)Normal Charge	VDC	110±10%	
	b) Float Charge	VDC	1.42 for 110±10%	
	c) Boost Charge	VDC	1.70 volt per cell	
	Output current (continuous)	A	Minimum 70	
8	Charger Control		As per specification	
9	Charger Protection			
	a)Protective Equipment		As per specification	
	b) Alarms		As per specification	
	c) Monitoring and Control		As per specification	
10	Rated Batter Current	A	To be mentioned	
11	Efficiency	%	To be mentioned	
12	Ripple voltage	%	To be mentioned	
13	Type of AVR		Static	
14	Standard		IEC-146	
C.	CHARGER CUBCLE COMPLETE			
1	Manufacturer		To be mentioned	
2	Overall dimensions		To be mentioned	
3	Total weight		To be mentioned	

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TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
For Air Conditioning System

(To be filled up by the tenderer with appropriate data, otherwise the Tender will be rejected) Failure to provide all of the information requested may lead to the rejection of the tender.

DESCRIPTION		BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
BRAND		Internationally Reputed (To be mentioned by the supplier)	
COMPANY		Internationally Reputed (To be mentioned by the supplier)	
MODEL		To be mentioned by the Supplier	
COUNTRY OF ORIGIN		Japan/Malaysia/South Korea/Taiwan/Thailand/USA/EU Countries	
COUNTRY OF ASSEMBLE		Japan/Malaysia/South Korea/Taiwan/Thailand/USA/EU Countries	
COOLING CAPACITY		28000-30000 BTU/HR	
OUTDOOR UNIT / CONDENSING UNIT	TYPE	Compact weather proof outdoor type condensing unit	
	COMPRESSOR	Hermitically sealed reciprocating/ Rotary compressor	
	REFRIGERANT	Internationally accepted & recommended and most commonly used gas (CFC free)	
	BLOWER MOTOR	Well balanced type direct driven centrifugal type blower fan	
	POWER SUPPLY	200-250 V, single phase, 50 Hz. AC supply	
	Inverter Type	Non-Inverter	
	CONDENSING PIPE/COIL	Made of copper	
	ENERGY EFFICIENCY RATIO (EER)	Minimum 9.23 (BTU/HR)/Watt.	
	COEFFICIENT OF PERFORMANCE (COP)	Minimum 2.70 (W/W)	
	OTHERS FEATURES	(a) Well balanced in all respect having interlock with the fan coil unit. (b) Compressor duly equipped with vibration isolator, thermostatic & overload controls, magnetic contactors and all other standard accessories complete. (c) Refrigerant copper pipe [From outdoor to indoor unit] with thermal insulation, refrigerant charging arrangement etc. [Minimum length 10 meters]. (d) Required size PVC insulated & sheathed, cable with ECC through water grade PVC pipe from outdoor to indoor unit. (e) Sound level: maximum 65 dB(A) at 1	

DESCRIPTION		BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
		meter.	
INDOOR UNIT/ FAN COIL UNIT	FEATURES	(a) Direct expansion system fan coil unit with well-balanced direct driven centrifugal type fan. (b) Fancy & adjustable air circulating louver grill, removable & washable type filter. (c) Condensing water drain out PVC flexible pipe with necessary insulation. (d) Thermostatic switch and remote-control switch. (e) Sound level: maximum 44 dB(A) at 1 meter.	
	STANDARD	Major component — shall be manufactured as per relevant international standard & code.	
	Mount Type	Wall Mounted.	
	WARRANTY	Compressor: 2 Year (Minimum); Service with spares: 2 Year (Minimum)	
	SUPPORTING DOCUMENTS	Must be supported by printed catalogue/manual. Authenticity document (Letter from the parent/authorized company or Verifiable QR/BAR Code and Others) must be supplied with product. If any confusion arises in validation, supplier must clarify any misconception/confusion.	

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Specification of Desktop Computer (Brand):

DESCRIPTION	BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
Brand	Internationally Reputed Brand	
Model	To be Mentioned by bidder	
Country of Origin	To be Mentioned by bidder	
Processor	Intel core i5 11 th Generation or Higher	
Speed	Turbo Boost System with Minimum 2.9 GHz, 6 Cores	
Cache	Minimum 9MB	
Chipset	Intel Express Chipset B400 Series or Equivalent or Higher	
RAM	Minimum 8GB 2666MHz DDR4L Memory, 2 DIMM slots	
HDD	Minimum 1TB 7200 RPM SATA	
SSD	Minimum 256GB M.2 NVMe PCIe	
LAN Card	Integrated Gigabit LAN-On-Motherboard	
Expansion Slots	Minimum (2) PCIe x 1, PCIe x 16	
Ports	Minimum (2) USB 3.0, (4) USB 2.0, RJ-45, HDMI, VGA/Display	
Wireless	Built-in Wireless 802.11/b/g/n (2.4 GHZ)	
Graphics (AGP)	Built-in	
Audio (Sound Card)	Built-in	
DVD-RW Drive	DVD+/-RW Drive	
Monitor	Minimum 18.5" LED Backlit Color, Same Brand	
Key-Board	USB enhanced, Same Brand	
Mouse	USB Optical Mouse, Same Brand	
Power Supply	Minimum 240 W PSU (APFC Full Charge)	
OS Support	Windows 10 or Higher.	
Software	Windows 10, Office & Other Software as per site requirements.	
Power Strip	Brand: Reputed Brand Port: Minimum 5 Port Cable Length: 3 meter Number of pin: Minimum 3 Others: Rated voltage: 220 V, Rated current: Minimum 10 A, Individual switch, Single fuse.	
Antivirus	Brand: To be Mentioned By the Bidder Internet Security Antivirus, license for 1 year	
Warranty	3 Years (Full).	

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Specification of Laptop (Brand):

DESCRIPTION	BREB REQUIREMENT	MANUFACTURER'S GUARANTEED DATA
Brand	Internationally Reputed Brand	
Model	To be Mentioned by bidder	
Country of Origin	To be Mentioned by bidder	
Processor	Intel Core i5 (11 th Generation) or Higher	
Speed	Turbo Boost System with Minimum 1.3 GHz	
Cache	Minimum 12 MB L3 Cache.	
RAM	Min. 8GB DDR4, 2666 MHz	
Display	Min. 14"HD LED	
Graphics	Intel HD Graphics	
SSD	Minimum M.2 NVMe™ 512 GB SSD	
Sound System	To be mentioned by the bidder	
Keyboard	Full-size 85 Keys US Keyboard.	
Mouse	Integrated pointing device with touch pad.	
Wireless	Integrated	
NIC	In-built with 10/100/1000	
Web cam	Integrated	
Slots	1 Multi-Format Digital Media Card Reader for Secure Digital cards, Multimedia Cards, Multimedia Cards	
Expansion Ports/Interface	Min. 3 USB 3.1, 1 HDMI, 1 Microphone/Headphone combo, 1 RJ-45	
Battery	Min. 6 Hours Back-up time, 3 Cell 41Whr.	
Power Supply	Universal 100 – 240V AC Adaptor for worldwide usage.	
Operating System	Free Dos	
Carrying Case	Including Original Carrying case	
Standard	ISO, CE & FCC Class-B.	
Warranty	3 Years.	

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TECHNICAL REQUIREMENT AND GUARANTEE SCHEDULE
LV AC / DC Distribution Panel

S/L	Description	Unit	Employer Requirement
DC DISTRIBUTION PANEL			
1	Manufacturer's name & country		To be mentioned
2	Rated normal current of Bus-bar	A	200
3	No. and size of fuse circuits	nos./ A	To be mentioned
4	Thickness of sheet steel (enclosure)	mm	To be mentioned
5	Dimension	mm x mm x mm	To be mentioned
6	Weight	Kg	To be mentioned
7	MCCB & MCB		
	a) Manufacturer's Name		To be mentioned
	b) Place of Manufacturer		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland
	c) Manufacturer's model no.		To be mentioned
	d) Rated voltage		To be mentioned
	e) Rated current		To be mentioned
8	Ammeter and Voltmeter Type		Digital
AC DISTRIBUTION PANEL			
1	Manufacturer's name & country		To be mentioned
2	Rated normal current of Bus-bar	A	400
3	No. and size of fused circuits	nos/ A	3
4	Thickness of sheet steel (enclosure)	mm	4
5	Dimension	mm x mm x mm	To be mentioned
6	Weight	Kg	To be mentioned
7	MCCB & MCB		
	a) Manufacturer's Name		To be mentioned
	b) Place of Manufacturer		UK/ USA/ EU/ Japan/ Canada/ Australia/ Switzerland
	c) Manufacturer's model no.		To be mentioned
	d) Rated voltage		To be mentioned
	e) Rated current		To be mentioned
8	Energy Meter		To be provided
9	Ammeter and Voltmeter Type		Digital

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Section 7. Drawings

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