The Government of the Democratic Socialist Republic of Sri Lanka
Funded By:
The Government of the Republic of India

Ministry of Power and Energy

Sri Lanka Sustainable Energy Authority

Procurement of Plants

Single-Stage, Two-Envelope
Bidding Procedure

BIDDING DOCUMENT
for

Construction of Hybrid Renewable Energy System in Small Islands – Delft, Analativu and Nainativu

Issued on:

Invitation for Bids No: SEA/PD/RES/25-2022

Employer: Sri Lanka Sustainable Energy Authority

Country: Democratic Socialist Republic of Sri Lanka

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Preface

This Bidding Document for Procurement of Plant – Design, Supply, and Installation, has been prepared by the Sri Lanka Sustainable Energy Authority and is based on the Standard Bidding Document for Procurement of Plant – Design, Supply, and Installation.

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PART 1 – Bidding Procedures

Section 1 - Instructions to Bidders

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Section 1 - Instructions to Bidders

A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids (IFB) indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues this Bidding Document for the procurement of plant and services as specified in Section 6 (Employer's Requirements). The name, identification, and number of lot/s (contract/s) of the Limited Competitive Bidding (LCB) are provided in the BDS.

1.2 Unless otherwise stated, throughout this Bidding Document definitions and interpretations shall be as prescribed in Section 7 (General Conditions of Contract) (GCC)).

2. Source of Funds

2.1 This project is funded by Government of Republic of India.

2.2 Payments by SLSEA will be made only at the progress made by the contractor.

3. Fraud and Corruption

3.1 Anticorruption Policy requires employer (including beneficiaries of financed activity) as well as Bidders, Suppliers, and Contractors under-financed contract, observe the highest standard of ethics during the procurement and execution of such contract.

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain

(iii)

(iv) a financial or other benefit or to avoid an obligation;

(v) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(vi) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

3.2 Furthermore, Bidders shall be aware of the provision stated in GCC 9.6 and GCC 42.2.1 (c).

4. Eligible Bidders

4.1 Only Indian firms (manufactures or Service providers) are eligible to participate in the procurement process

[1] Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other capacity (different names are used depending on the particular Bidding Document).

4.2 Definition of an Indian firm - This exercise is open to only Indian Applicants. An Applicant shall be deemed to be Indian if the Applicant is constituted, incorporated or registered in, and operates in accordance with the provisions of the laws of India, as evidenced by its articles of incorporation and its registration documents, as the case may be. Applicants incorporated in India, with Indian holding less than 76% shall not be eligible to apply. In case of a Joint Venture (JV), each member of the JV, involved or intended to be involved with this prequalification process should be eligible to apply.

4.3 Blacklisting/debarring - An Applicant that has been blacklisted/ debarred/ sanctioned by any Multilateral Development Agency (MDA) or any authority in India or Sri Lanka in accordance with extant rules and procedures, shall be ineligible to participate in the prequalification/ bidding process as applicable, during such period of time as the sanctioning authority shall have determined. In case the Applicant is blacklisted/ debarred/sanctioned, post the prequalification process (i.e. including during bidding process and/or contract implementation phase), the Applicant shall immediately inform SLSEA of such blacklisting/debarment/sanction and reasons thereof. This may lead to cancellation of Applicant's prequalification / contract.

4.4 Ineligibility: An Applicant shall be ineligible to be prequalified if (a) it is currently under default on any loan to any Bank/ Financial Institution (FI) and its account has been classified as Non-Performing Asset (NPA) as per Central Repository of Information on Large Credits (CRILC) database; and/or (b) its promoters/directors appear in Negative List, RBI Wilful Defaulter List (Suit filed as well as non-suit filed), Credit Information Bureau India Ltd. (CIBIL) Defaulter List and/or any other negative list of central and/or state government agencies, updated from time-to-time. On being included in any of the above lists post the prequalification process (i.e. including during bidding process and/or Project contract implementation phase), the Applicant shall immediately inform SLSEA on the inclusion and reasons for inclusion thereof. This may lead to cancellation of Applicant's prequalification / contract. Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer (SLSEA), as the Employer shall reasonably request.

4.5 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.

5. Eligible Plant and Services

5.1 The plant and services to be supplied under the Contract shall have their origin in eligible source countries as defined in ITB 4.2 and all expenditures under the Contract will be limited to such plant and services. Notwithstanding the provisions contained in ITB 4.2, in essential and exceptional cases wherein there is a need for procurement of services and material from a country in relaxation of ITB 4.2, the contractor/company has to mandatorily obtain specific written approvals from the employer (SLSEA) as well as the Joint Project Monitoring Committee, governing the execution of the project.

5.2 For purposes of ITB 5.1 above, "origin" means the place 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 in its basic characteristics or in purpose or utility from its components.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Document consists of Parts I, II, and III, which include all the sections indicated below, and should be read in conjunction with any addenda issued in accordance with ITB 8.

PART I Bidding Procedures
Section 1 - Instructions to Bidders (ITB)
Section 2 - Bid Data Sheet (BDS)
Section 3 - Evaluation and Qualification Criteria (EQC)
Section 4 - Bidding Forms (BDF)
Section 5 - Eligible Countries (ELC)

PART II Requirements
Section 6 - Employer's Requirements (ERQ)

PART III Conditions of Contract and Contract Forms
Section 7 - General Conditions of Contract (GCC)
Section 8 - Special Conditions of Contract (SCC)
Section 9 - Contract Forms (COF)

6.2 The IFB issued by the Employer is not part of the Bidding Document.

6.3 The Employer is not responsible for the completeness of the Bidding Document and its addenda, if they were not obtained directly from the source stated by the Employer in the IFB.

6.4 The Bidder is expected to examine all instructions, forms, terms, and Specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the Bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1 A prospective Bidder requiring any clarification on the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS, or raise inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond to any request for clarification, provided that such request is received no later than 21 days prior to the deadline for submission of bids. The Employer's response shall be in writing with copies to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 24.2.

7.2 The Bidder 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 Bid and entering into a contract for the provision of plant and services. The costs of visiting the site shall be at the Bidder's own expense.

7.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents, will release and indemnify the Employer 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.

7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 The Bidder is requested to submit any questions in writing, to reach the Employer not later than 1 week before the pre-bid meeting.

7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of Bids, the Employer may amend the Bidding Document by issuing addenda.

8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may, at its discretion, extend the deadline for the submission of Bids, pursuant to ITB 24.2

A.Preparation of Bids

9. Cost of Bidding

9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the English language. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages into the English language, in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1 The Bid shall comprise two envelopes submitted simultaneously, one containing the Technical Bid and the other the Price Bid, both envelopes enclosed together in an outer single envelope.

11.2 The Technical Bid submitted by the Bidder shall comprise the following:

(a) Letter of Technical Bid;

(b) Bid Security or Bid-Securing Declaration, in accordance with ITB 21;

(c) alternative Bids, if permissible, in accordance with ITB 13;

(d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 22.2;

(e) documentary evidence in accordance with ITB 14.1, that the plant and services offered by the Bidder in its Bid or in any alternative Bid, if permitted, are eligible;

(f) documentary evidence in accordance with ITB 15, the Bidder's eligibility and qualifications to perform the contract if its Bid is accepted;

(g) Technical Proposal in accordance with ITB 17.

(h) documentary evidence in accordance with ITB 16, that the plant and services offered by the Bidder conform to the Bidding Document;

(i) in the case of a bid submitted by a Joint Venture, the Bid shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement;

(j) list of subcontractors*, in accordance with ITB 17.2; and
*The contractor, to the extent possible, shall engage only Indian subcontractors. In case of engaging a subcontractor from outside India, the contractor/company has to mandatorily obtain specific written approvals from the employer (SLSEA) as well as the Joint Project Monitoring Committee, governing the execution of the project.

(k) any other document required in the BDS.

11.3 The Price Bid submitted by the Bidder shall comprise the following:

(a) Letter of Price Bid;

(b) completed schedules as required, including Price Schedules, in accordance with ITB 12 and ITB 18;

(c) alternative price Bids, if permissible, in accordance with ITB 13; and

(d) any other document required in the BDS.

12. Letter of Bid and Schedules

12.1 The Letters of Technical Bid and Price Bid, and the Schedules, and all documents listed under ITB 11, shall be prepared using the relevant forms furnished in Section 4 (Bidding Forms). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested and as required in the BDS.

13. Alternative Bids

13.1 *Deleted*

14. Documents Establishing the Eligibility of Plant and Services

14.1 To establish the eligibility of the plant and services in accordance with ITB 5, Bidders shall complete the country of origin declarations in the Price Schedule Forms, included in Section 4 (Bidding Forms).

15. Documents Establishing the Eligibility and Qualifications of the Bidder

15.1 To establish its eligibility and qualifications to perform the Contract in accordance with Section 3 (Evaluation and Qualification Criteria), the Bidder shall provide the information requested in the corresponding information sheets included in Section 4 (Bidding Forms).

16. Documents Establishing Conformity of the Plant and Services

16.1 The documentary evidence of the conformity of the plant and services to the Bidding Document may be in the form of literature, drawings and data, and shall furnish:

(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 BDS, following completion of plant and services in accordance with provisions of the contract; and

(c) a commentary on the Employer's Specifications and adequate evidence demonstrating the substantial responsiveness of the plant and services to those specifications. Bidders shall note that standards for workmanship, materials and equipment designated by the Employer in the Bidding Document are intended to be descriptive (establishing standards of quality and performance) only and not restrictive. The Bidder may substitute alternative standards, brand names and/or catalog numbers in its Bid, provided that it demonstrates to the Employer's satisfaction that the substitutions are substantially equivalent or superior to the standards designated in the Specifications.

17. Technical Proposal, Subcontractors

17.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section 4 (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.

17.2 For major items of plant and services as listed by the Employer in Criterion 2.5 of Section 3 (Evaluation and Qualification Criteria), which the Bidder intends to purchase or subcontract, the Bidder shall give details of the name and nationality of the proposed Subcontractors, including Manufacturers, for each of those items. In addition, the Bidder shall include in its Bid information establishing compliance with the requirements specified by the Employer for these items. Bidders are free to list more than one Subcontractor against each item of the plant and services. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

17.3 The Bidder shall be responsible for ensuring that any Subcontractor proposed complies with the requirements of ITB 4, and that any plant, or services to be provided by the Subcontractor comply with the requirements of ITB 5 and ITB 15.1

18. Bid Prices and Discounts

18.1 Unless otherwise specified in the BDS and/or Section 6 (Employer's Requirements), bidders shall quote for the entire plant and services on a "single responsibility" basis such that the total Bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the Bidding 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 Bidding 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 Bidding Document, all in accordance with the requirements of the General Conditions. Items against which no price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed to be covered by the prices for other items.

18.2 Bidders are required to quote the price for the commercial, contractual and technical obligations outlined in the Bidding Document.

18.3 Bidders shall give a breakdown of the prices in the manner and detail called for in the Price Schedules included in Section 4 (Bidding Forms). Where no different Price Schedules are included in the Bidding Document, Bidders shall present their prices in the following manner: Separate numbered Schedules included in Section 4 (Bidding Forms) shall be used for each of the following elements. The total amount from each Schedule (Nos. 1 to 4) shall be summarized in a Grand Summary (Schedule No. 5) giving the total bid price(s) to be entered in the Letter of Price Bid. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the Bid.

Schedule No. 1: Plant and Mandatory Spare Parts Supplied from Abroad

Schedule No. 2: Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

Schedule No. 3: Design Services

Schedule No. 4: Installation and Other Services

Schedule No. 5 Grand Summary (Schedule Nos. 1 to 4)

Schedule No. 6: Recommended Spare Parts

Bidders shall note that the plant and mandatory spare parts 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 and Other Services.

18.4 In the Schedules, Bidders shall give the required details and a breakdown of their prices as follows:

(a) Plant to be Supplied from Abroad* (Schedule No. 1):

(i) the price of the plant shall be quoted carriage and insurance paid (CIP)-named place of destination basis specified in the BDS;

(ii) all customs duties and other taxes paid or payable in the Employer's country on the plant if the contract is awarded to the Bidder; and

(iii) the total price for the plant.

*Procurement of machinery, material and services from abroad shall be governed as per clause 5.1 in Section 1- Instruction to Bidders.

(b) Plant Supplied from Within the Employer's Country (Schedule No. 2):

(i) the price of the plant shall be quoted on an EXW Incoterm basis (ex works, ex factory, ex warehouse, ex showroom, as applicable), including all customs duties and sales and other taxes already paid or payable on the components and raw material used in the manufacture or assembly of plant quoted ex works or ex factory, or on the previously imported plant of foreign origin quoted ex warehouse, ex showroom;

(ii) sales tax and other taxes payable in the Employer's country on the plant if the contract is awarded to the Bidder, and

(iii) the total price for the plant.

(c) Design Services. (Schedule No. 3). Rates or prices shall include all taxes, duties, levies, and charges payable in the Employer's country as of 28 days prior to the deadline for submission of Bids.

(d) Installation and Other Services (Schedule No. 4) shall be quoted separately and shall include rates or prices for local transportation, 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 Bidding Document, as necessary for the proper execution of the installation and other services, including all taxes, duties, levies, and charges payable in the Employer's country as of 28 days prior to the deadline for submission of bids.

(e) Recommended spare parts (Schedule No. 6) shall be quoted separately as specified in either subparagraph (a) or (b) above in accordance with the origin of the spare parts.

18.5 The current edition of Incoterms, published by the International Chamber of Commerce shall govern.

18.6 The prices shall be either fixed or adjustable as specified in the BDS.

(a) In the case of Fixed Price, prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account. A Bid submitted with an adjustable price quotation will be treated as nonresponsive and rejected.

(b) In the case of Adjustable Price, prices quoted by the Bidder 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 Bid

submitted with a fixed price quotation will not be rejected, but the price adjustment will be treated as zero. Bidders are required to indicate the source of labor and material indexes in the corresponding Form in Section 4 (Bidding Forms).

18.7 If so indicated in BDS 1.1, Bids are being invited for individual lots (contracts) or for any combination of lots (packages). Bidders wishing to offer any price reduction (discount) for the award of more than one contract shall specify in their Letter of Price Bid 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.

19. Currencies of Bid and Payment

19.1 The currency(ies) of the bid shall be, as specified in the BDS.

20. Period of Validity of Bids

20.1 Bids shall remain valid for the period specified in the BDS after the bid submission deadline date prescribed by the Employer. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.

20.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 21, it shall also be extended 30 days beyond the deadline of the extended bid validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid.

21. Bid Security/ Bid Securing Declaration

21.1 Unless otherwise specified in the BDS, the Bidder shall furnish as part of its Bid, in original form, either a Bid-Securing Declaration or a bid security as specified in the BDS. In the case of a bid security, the amount and currency shall be as specified in the BDS.

21.2 If a Bid-Securing Declaration is required pursuant to ITB 21.1, it shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a Contract for a specified period of time, as indicated in the BDS, if a Bid-Securing Declaration is executed.

21.3 If a bid security is specified pursuant to ITB 21.1, the bid security shall be, at the Bidder's option, in any of the following forms:

(a) an unconditional bank guarantee,

(b) an irrevocable letter of credit, or

(c) a cashier's or certified check,

all from a reputable source from an eligible country as described in Section 5 (Eligible Countries). In the case of a bank guarantee, the bid security shall be submitted using either the Bid Security Form included in Section 4 (Bidding Forms) or another form acceptable to the Employer. The form must include the complete name of the Bidder. The bid security shall be valid for 28 days beyond the original validity period of the Bid, or beyond

any period of extension if requested under ITB 20.2.

21.4 Unless otherwise specified in the BDS, any Bid not accompanied by a substantially compliant bid security or Bid-Securing Declaration, if one is required in accordance with ITB 21.1, shall be rejected by the Employer as nonresponsive.

21.5 If a bid security is specified pursuant to ITB 21.1, the bid security of the unsuccessful Bidder shall be returned as promptly as possible upon the successful Bidder's furnishing of the performance security pursuant to ITB 45.

21.6 If a bid security is specified pursuant to ITB 21.1, the bid security of successful Bidders shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required performance security.

21.7 The bid security may be forfeited or the Bid-Securing Declaration executed:

(a) if a Bidder withdraws its Bid during the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid, except as provided in ITB 20.2 or

(b) if the successful Bidder fails to:

(i) sign the Contract in accordance with ITB 44;

(ii) furnish a performance security in accordance with ITB 45; or

(iii) accept the arithmetical corrections of its Bid in accordance with ITB 36.

21.8 The bid security or the Bid-Securing Declaration of a Joint Venture shall be in the name of the Joint Venture that submits the Bid. If the Joint Venture has not been legally constituted at the time of bidding, the bid security or the Bid-Securing Declaration shall be in the names of all future partners as named in the letter of intent referred to in ITB 4.1.

22. Format and Signing of Bid

22.1 The Bidder shall prepare one original set of the Technical Bid and one original set of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID". Alternative bids, if permitted in accordance with ITB 13, shall be clearly marked "ALTERNATIVE". In addition, the Bidder shall submit copies of the Bid, in the number specified in the BDS and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

22.2 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the Bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid, except for unamended printed literature, shall be signed or initialed by the person signing the Bid. If a Bidder submits a deficient authorization, the Bid shall not be rejected in the first instance. The Employer shall request the Bidder to submit an acceptable

authorization within the number of days as specified in the BDS. Failure to provide an acceptable authorization within the prescribed period of receiving such a request shall cause the rejection of the Bid.

22.3 A Bid submitted by a Joint Venture shall be signed so as to be legally binding on all partners.

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

A. Submission and Opening of Bids

23. Submission, Sealing, and Marking of Bids

23.1 Bidders may submit their Bids by mail or by hand. When so specified in the BDS, Bidders shall have the option of submitting their Bids electronically. Procedures for submission, sealing and marking are as follows:

(a) Bidders submitting Bids by mail or by hand shall enclose the original and each copy of the Bid, including alternative Bids, if permitted in accordance with ITB 13, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL," "ALTERNATIVE," and "COPY." These envelopes containing the original and the copies shall then be enclosed in one single envelope. The rest of the procedure shall be in accordance with ITB 23.2 to ITB 23.6.

(b) Bidders submitting Bids electronically shall follow the electronic bid submission procedures specified in the BDS.

23.2 The inner and outer envelopes shall

(a) bear the name and address of the Bidder,

(b) be addressed to the Employer in accordance with ITB 24.1, and

(c) bear the specific identification of this bidding process indicated in the BDS 1.1.

23.3 The outer envelopes and the inner envelopes containing the Technical Bid shall bear a warning not to open before the time and date for the opening of Technical Bid, in accordance with ITB 27.1.

23.4 The inner envelopes containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 27.7.

23.5 Alternative Bids, if permissible in accordance with ITB 13, shall be prepared, sealed, marked, and delivered in accordance with the provisions of ITB 20 and ITB 21, with the inner envelopes marked in addition "ALTERNATIVE NO…." as appropriate.

23.6 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

24. Deadline for Submission of Bids

24.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.

24.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

25. Late Bids

25.1 The Employer shall not consider any Bid that arrives after the deadline for submission of Bids, in accordance with ITB 24. Any Bid received by the Employer after the deadline for submission of Bids shall be declared late, rejected, and returned unopened to the Bidder.

26. Withdrawal, Substitution, and Modification of Bids

26.1 A Bidder may withdraw, substitute, or modify its Bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 22.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the Bid must accompany the respective written notice. All notices must be:

(a) prepared and submitted in accordance with ITB 22 and ITB 23 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL," "SUBSTITUTION," "MODIFICATION;" and

(b) received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 24.

26.2 Bids requested to be withdrawn in accordance with ITB 26.1 shall be returned unopened to the Bidders.

26.3 No Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Technical Bid or any extension thereof.

27. Bid Opening

27.1 The Employer shall open the Technical Bids in public at the address, on the date, and time specified in the BDS in the presence of Bidder's designated representatives and anyone who choose to attend. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 23.1, shall be as specified in the BDS. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and the Price Bid are submitted together in one envelope, the Employer may reject the entire Bid. Alternatively, the Price Bid may be immediately resealed for later evaluation.

27.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.

27.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with ITB 27.1. 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 bid opening.

27.4 Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original as well as Modification, will remain unopened in accordance with ITB 27.1.

27.5 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the presence of a bid security or a Bid-Securing Declaration, if required; and

(d) any other details as the Employer may consider appropriate.

Only Technical Bids and alternative Technical Bids read out and recorded at bid opening shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Technical Bid are to be initialed by at least three representatives of the Employer attending the bid opening. No Bid shall be rejected at the opening of Technical Bids except for late Bids, in accordance with ITB 25.1.

27.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification; and alternative Bids; and the presence or absence of a bid security or a Bid-Securing Declaration, if one was required. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

27.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice of the opening of Price Bids.

27.8 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially nonresponsive to the requirements of the Bidding Document and return their Price Bids unopened.

27.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders` representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.

27.10 All envelopes containing Price Bids shall be opened one at a time and the

following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the Bid Prices, including any discounts and alternative offers; and

(d) any other details as the Employer may consider appropriate.

Only Price Bids, discounts, and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Price Bid and Price Schedules are to be initialed by at least three representatives of the Employer attending bid the opening. No Bid shall be rejected at the opening of Price Bids.

27.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum: the name of the Bidder, the Bid Price (per lot if applicable), any discounts, and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

B. Evaluation and Comparison of Bids

28. Confidentiality

28.1 Information relating to the evaluation of Bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on the Contract award is communicated to all Bidders.

28.2 Any attempt by a Bidder to influence the Employer in the evaluation of the Bids or Contract award decisions may result in the rejection of its Bid.

28.3 Notwithstanding ITB 28.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it should do so in writing.

29. Clarification of Bids

29.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, and qualification of the Bidders, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids, in accordance with ITB 36.

29.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.

30. Deviations, Reservations, and Omissions

30.1 During the evaluation of Bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

31. Examination of Technical Bids

31.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB 11.2 have been provided, and to determine the completeness of each document submitted. If any of these documents or information is missing, the Bid may be rejected.

31.2 The Employer shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

(a) Letter of Technical Bid;

(b) written confirmation of authorization to commit the Bidder;

(c) Bid Security or Bid-Securing Declaration, if applicable; and

(d) Technical Proposal in accordance with ITB 17.

32. Responsiveness of Technical Bid

32.1 The Employer's determination of a bid's responsiveness is to be based on the contents of the Bid itself, as defined in ITB11.

32.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the plant and services specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive Bids.

32.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 17, Technical Proposal, in particular to confirm that all requirements of Section 6 (Employer's Requirements) have been met without any material deviation, reservation, or omission.

32.4 If a Bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

33. Nonmaterial Nonconformities

33.1 Provided that a Bid is substantially responsive, the Employer may waive any nonconformities in the Bid that do not constitute a material deviation, reservation, or omission.

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

33.3 Provided that a Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section 3 (Evaluation and Qualification Criteria).

34. Detailed Evaluation of Technical Bids

34.1 The Employer will carry out a detailed technical evaluation of the Bids not previously rejected as being substantially nonresponsive, to determine whether the technical aspects are in compliance with the Bidding Document. The Bid that does not meet minimum acceptable standards of completeness, consistency, and detail, and the specified minimum and/or maximum requirements for specified functional guarantees, will be treated as nonresponsive and hence rejected. To reach such a determination, the Employer will examine and compare the technical aspects of the bids on the basis of the information supplied by the Bidders, taking into account the following:

(a) overall completeness and compliance with the Employer's Requirements; deviations from the Employer's Requirements; conformity of the plant and services offered with specified performance criteria; suitability of the plant and services offered in relation to the environmental and climatic conditions prevailing at the site; and quality, function and operation of any process control concept included in the Bid. The Bid that does not meet minimum and/or maximum acceptable standards of completeness, consistency, and detail will be rejected for non-responsiveness;

(b) type, quantity, and long-term availability of mandatory and recommended spare parts and maintenance services; and

(c) other relevant factors, if any, listed in Section 3 (Evaluation and Qualification Criteria).

34.2 Where alternative technical solutions have been allowed in accordance with ITB 13, and offered by the Bidder, the Employer will make a similar evaluation of the alternatives. Where alternatives have not been allowed but have been offered, they shall be ignored.

35. Eligibility and Qualification of the Bidder

35.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether a Bidder meets the eligibility and qualifying criteria specified in Section 3 (Evaluation and Qualification Criteria).

35.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 15.

35.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

35.4 The capabilities of the manufacturers and subcontractors proposed in its Bid for the major items of plant and services to be used by the Bidders will also be evaluated for acceptability in accordance with Section 3 (Evaluation and Qualification Criteria). Their participation should be confirmed with a letter of intent between the parties, as needed. Should a manufacturer or subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to propose, without changing its bid price, an acceptable substitute manufacturer or subcontractor meeting the minimum technical specifications stated in Section 6 (Employer's Requirements). If a Bidder does not provide an acceptable substitute manufacturer or subcontractor by the date and time set in the Employer's request for substitution of manufacturer or subcontractor, its Bid may be rejected.

35.5 Prior to signing the Contract, the corresponding Appendix to the Contract Agreement shall be completed, listing the approved manufacturers or subcontractors for each item concerned.

36. Correction of Arithmetical Errors

36.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

(a) where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the amounts given under the column for the price breakdown shall prevail and the Total Price will be corrected accordingly;

(b) where there are errors between the total of the amounts of Schedule Nos. 1 to 4 and the amount given in Schedule No. 5 (Grand Summary), the total of the amounts of Schedule Nos. 1 to 4 shall prevail and the Schedule No. 5 (Grand Summary) will be corrected accordingly;

(c) if there is a discrepancy between the grand total price given in Schedule No. 5 (Grand Summary) and the bid amount in item (c) of the Letter of Price Bid, the grand total price given in Schedule No. 5 (Grand Summary) will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected; and

(d) 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 arithmetical error, in which case the amount in figures shall prevail subject to (a), (b), and (c) above.

36.2 If the Bidder that submitted the lowest evaluated Bid does not accept the correction of errors, its Bid shall be disqualified and its bid security may be forfeited or its Bid-Securing Declaration executed.

37. Conversion to Single Currency

37.1 For evaluation and comparison purposes, the currency(ies) of the Bid shall be converted into a single currency as specified in the BDS .

38. Margin of Preference

38.1 Unless otherwise specified in the BDS, a margin of preference shall not apply.

39. Evaluation of Price Bids

39.1 The Employer shall use the criteria and methodologies listed in this clause. No other evaluation criteria or methodologies shall be permitted.

39.2 I. To evaluate a Price Bid, the Employer shall consider the following:

(a) the bid price, excluding provisional sums and the provision, if any, for contingencies in the Price Schedules;

(b) price adjustment for correction of arithmetical errors in accordance with ITB 36.1;

(c) price adjustment due to discounts offered in accordance with ITB 18.7;

(d) price adjustment due to quantifiable nonmaterial nonconformities in accordance with ITB 33.3;

(e) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITB 37; and

(f) the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria).

II. The Employer's evaluation of a Bid will exclude and not take into account,

(a) in the case of Plant and Mandatory Spare Parts (Schedule No. 1) supplied from abroad, all taxes and duties, applicable in the Employer's country and payable on the Plant and Mandatory Spare Parts if the Contract is awarded to the Bidder; and

(b) in the case of Plant and Mandatory Spare Parts (Schedule No. 2) supplied from within the Employer's country, sales and other taxes, applicable in the Employer's country and payable on the Plant and Mandatory Spare Parts if the Contract is awarded to the Bidder.

39.3 If price adjustment is allowed in accordance with ITB 18.6, the estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

39.4 If this Bidding Document allows Bidders to quote separate prices for different lots (contracts), and the award to a single Bidder of multiple lots (contracts), the methodology to determine the lowest evaluated price of the lot (contract) combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification Criteria).

39.5 If the Bid, which results in the lowest Evaluated Bid Price, is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Price Schedules, to demonstrate the internal consistency of those prices with the methods and time schedule proposed. After evaluation of the price analyses, taking into consideration the terms of payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

40. Comparison of Bids

40.1 The Employer shall compare all substantially responsive Bids to determine the lowest evaluated Bid, in accordance with ITB 39.2.

41. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

41.1 The Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all Bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

C. Award of Contract

42. Award Criteria

42.1 The Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated Bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be eligible and qualified to perform the Contract satisfactorily.

43. Notification of Award

43.1 Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, that its Bid has been accepted.

43.2 At the same time, the Employer shall also notify all other Bidders of the results of the bidding. The Employer will publish in an English language newspaper or well-known freely accessible website the results identifying the Bid and lot numbers, and the following information: (i) name of each Bidder who submitted a bid; (ii) bid prices as read out at bid opening; (iii) name and evaluated prices of each bid that was evaluated; (iv) name of Bidders whose Bids were rejected and the reasons for their rejection; and
(v) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded. After publication of award, unsuccessful Bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their Bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, after publication of contract award, request for a debriefing.

43.3 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

44. Signing of Contract

44.1 Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

44.2 Within 28 days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

45. Performance Security

45.1 Within 28 days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 39.5, using for that purpose the Performance Security Form included in Section 9 (Contract Forms), or another form acceptable to the Employer.

45.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security or execution of the Bid-Securing Declaration. In that event, the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily.

Section 2 - Bid Data Sheet

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section 1 - Instructions to Bidders.

A. General

ITB 1.1	The number of the Invitation for Bids (IFB) is : SEA/PD/RES/25-2022 The Employer is: Sri Lanka Sustainable Energy Authority The name of the limited competitive bidding (LCB) is: Construction of Hybrid Renewable Energy System in Small Islands The identification number of the LCB is: SEA/PD/RES/25-2022 This is single contract with the same identification number as the LCB identification number : SEA/PD/RES/25-2022
ITB 2.1	The Employer is: Sri Lanka Sustainable Energy Authority The name of the Project is: Construction of Hybrid Renewable Energy System in Small Islands

B. Contents of Bidding Documents

ITB 7.1	For **clarification purposes** only, the Employer's address is: Director General, Sri Lanka Sustainable Energy Authority Street address: No. 72, Ananda Coomaraswamy Mawatha, Colombo 07. ZIP code: 00700 Country: Sri Lanka Telephone: +94 112575030 Fax: + 94 112575089 E-mail : info@energy.gov.lk

ITB 7.4	A Pre-Bid meeting will be arranged. The date, time and place are as follows : Date: **13.10.2022** Time: **10.00 a.m. Colombo Time** Place: **Board Room, SLSEA, No. 72, Ananda Coomaraswamy Mawatha, Colombo 07** The site visit will be organized by the Employer. All the self-arrangements and expenses for the site visit should be borne by the bidder. **Day 01 (10.10.2022) –** Visit to Nainathivu Island and Analathivu Island**.** **Day 02 (11.10.2022) –** Visit to Delft Island

C. Preparation of Bids

ITB 11.2 (k)	The Bidder shall submit with its Technical Bid the following additional documents: 1. Information requested under clauses 2.11, 3.5, 4.9, 5.9, 6.8, 10.6. of specifications in Section 6-Employer's Requirement. 2. The bidder shall submit the form "Agreement for Re-Supplying, installation and disposal of Li-Ion/LFP Batteries" in Section 9. 3. Business Registration
ITB 11.3 (d)	The Bidder shall submit with its Price Bid the following additional documents: Not Applicable
ITB 12.1	The units and rates in figures entered into the Price Schedules should be typewritten or if written by hand, must be in print form. Price Schedules not presented accordingly may be considered nonresponsive.
ITB 13.1	Alternative bids are Not Permitted.

ITB 13.2	Alternatives to the Time Schedule shall not be permitted.
ITB 13.4	Alternative technical solutions are **NOT** permitted.
ITB 16.1 (b)	The period following completion of plant and services in accordance with provisions of contract shall be 10 years
ITB 18.1	Bidders shall quote for the entire plant and services on a single responsibility basis.
IT 18.4(a)(i)	The Incoterm for quoting plant to be supplied from abroad is: CIP Places of destination : Proposed sites at Nainativu, Analativu and Delft
ITB 18.6	The prices quoted by the Bidder shall be adjustable. The price adjustment will be specified in the Appendix 2 of Section 9 : Contract Forms.
ITB 19.1	The currencies of the Bid shall be as follows: (a) The prices shall be quoted USD only.
ITB 20.1	The bid validity period shall be 189 days.

ITB 21.1	. Bid security declarations are **not** permitted. ***Note**: An irrevocable letter of credit or a cashier's certified cheque is **not** acceptable*
ITB 21.2	Not Applicable
ITB 21.3	Bid Security shall be; *(a) An unconditional bank guarantee issued by a bank approved by the Central Bank of Sri Lanka and operating in Sri Lanka or issued by a bank based in another country but the bid security certified by a bank approved by the Central Bank of Sri Lanka and operating in Sri Lanka.* ***Note**: An irrevocable letter of credit or a cashier's certified cheque is **not** acceptable*
ITB 21.4	Subject to the succeeding sentences, any bid not accompanied by an irrevocable and callable bid security shall be rejected by the Employer as nonresponsive. If a Bidder submits a bid security that (i) deviates in form, amount, and/or period of validity, or (ii) does not provide sufficient identification of the Bidder (including, without limitation, failure to indicate the name of the Joint Venture or, where the Joint Venture has not yet been constituted, the names of all future Joint Venture Partners), the Employer shall request the Bidder to submit a compliant bid security within 14 days of receiving such a request. Failure to provide a compliant bid security within the prescribed period of receiving such a request shall cause the rejection of the Bid.
ITB 22.1	In addition to the original of the Bid, the number of copies is: 1 Marking the envelopes of bids as "ORIGINAL" and "DUPLICATE".
ITB 22.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of an organizational document, board resolution or its equivalent, or power of attorney specifying the representative's authority to sign the Bid on behalf of, and to legally bind, the Bidder. If the Bidder is an intended or an existing Joint Venture, the power of attorney should be signed by all partners and specify the authority of the named representative of the Joint Venture to sign on behalf of, and legally bind, the intended or existing Joint Venture. If the Joint Venture has not yet been formed, also include evidence from all proposed Joint Venture partners of their intent to enter into a Joint Venture in the event of a contract award in accordance with ITB 11.2."
ITB 22.2	The Bidder shall submit an acceptable authorization within 14 days.

D. Submission and Opening of Bids

ITB 23.1	Bidders shall not have the option of submitting their bids electronically.
ITB 23.1 (b)	electronic bidding submission procedures is **Not Applicable**

ITB 23.2 (c)	The additional identification marks are : Bid Number, date of bid opening shall be indicated in left hand corner of the each envelop.
ITB 24.1	For **bid submission purposes** only, the Employer's address is Attention: **Chairman, Bid Opening Committee** Street address: **SLSEA, No.72, Ananda Coomarswamy Mawatha, Colombo 07.** City: **Colombo** ZIP code: **00700**
	Country: **Sri Lanka** **The deadline for bid submission is** Date: **11.11.2022** Time: **11.00 a.m. Colombo Time**
ITB 27.1	The bid opening of Technical Bids shall take place at **SLSEA** Street address: **No.72, Ananda Coomarswamy Mawatha, Colombo 07** Country: **Sri Lanka** Date: **11.11.2022** Time: **11.00 a.m. Colombo Time**
ITB 27.1	With Reference to Electronic Bid: Not Applicable
ITB 27.5	The Letter of Technical Bid shall be initialed by three (3) representatives of the Employer attending Technical Bid opening.
ITB 27.10	The Letter of Price Bid and Price Schedules shall be initialed by three (3) representatives of the Employer attending the Price Bid opening.

E. Evaluation and Comparison of Bids

ITB 37.1	The currency that shall be used for bid evaluation and comparison purposes to convert all bid prices expressed in various currencies into a single currency is: Currency of Sri Lanka; Sri Lanka Rupee (LKR). The source of the selling exchange rate shall be: Selling exchange rate determined by the Central Bank of Sri Lanka The date for the selling exchange rate shall be: Date of opening of the technical bids
ITB 38.1	A margin of preference shall not apply.

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1. Evaluation

1.1 Technical Evaluation

In addition to the criteria listed in ITB 34.1 (a) – (b), other relevant factors are as follows:

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section 6 (Employer's Requirements).

Non-compliance with equipment and personnel requirements described in Section 6 (Employer's Requirements) shall not normally be a ground for bid rejection and such non-compliance will be subject to clarification during bid evaluation and rectification prior to contract award.

The contractor shall provide Technical Proposal in accordance with the structure provided in section 4 for site organization, method statement, mobilization, construction schedule, plant, personal, equipment, proposed subcontractors for major items of plant and services, and time schedule. They shall be presented in a consistent manner and shall comply requirements stipulated in Section 6 (Employer's Requirements) without material deviation, reservation, or omission.

1.2 Alternative Technical Solutions

Not Applicable

1.3 Economic Evaluation

In addition to the criteria listed in ITB 39.2 I (a)–(e), other relevant factors are as follows:

Adjustments in price that result from the procedures outlined below shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by Bidders shall remain unaltered.

1.3.1 Quantifiable Deviations and Omissions

Quantifiable Deviations and Omissions from the contractual obligations: the evaluation shall be based on the evaluated cost of fulfilling the contract in compliance with all contractual obligations under this Bidding Document.

Pursuant to ITB 33.3, the cost of all quantifiable nonmaterial nonconformities or omissions from the contractual and commercial conditions shall be evaluated. The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of Bids.

1.3.2 Time Schedule

Time to complete the plant and services from the effective date specified in Article 3 of the Contract Agreement for determining the time for completion of pre-commissioning activities is **200 days**. No credit will be given for earlier completion.

1.3.3 Operating and Maintenance Costs

Not Applicable

1.3.4 Functional Guarantees of the Facilities

The minimum and/or maximum requirements stated in the Specification for functional guarantees required in the Specification are:

Functional Guarantee	Minimum and/or Maximum Requirements		
Diesel Generator			
Islands	**Nainativu**	**Delft**	**Analativu**
Generator Prime Capacities	According to the design	According to the design	According to the design
Rated Frequency	50 Hz		
Rated Output Voltage	230 / 400 V		
Electrical Parameters			
Total Harmonic Distortion	< 5%		
AVR self-regulated, voltage regulation rate	≤ ±1%		
Other			
Steady voltage regulation	< ±0.5%		
Noise Level	At Boundaries - 55 dB(day) , 45 dB (Night), +3dB Tolerances apply		
	Inside the Generator House - 60 dB(day) , 45 dB (Night), +5dB (day), +3dB(Night) Tolerances Apply		
PV Panels			
Minimum Power of a PV module at STC conditions (Pmax) – Calculated With correction factors	According to the design		
Maximum output fault current	5 kA		
Solar Inverter			
DC input			
Maximum DC input voltage	1000 V		
AC output			
Rated grid voltage (single phase/Three phase)	230/400 V		
Rated Output Frequency	50 Hz		
Power factor	0.95 inductive to 0.95 capacitive		
Maximum Total Harmonic Distortion	4%		

General	
Maximum Allowable Noise level	55 dB
Wind Generator	
Rated Output Voltage of the Generator	400/230 V
power output at rated condition	According to the design
Maximum Noise Level measured in Accordance with IEC 61400-1	40 dB
Rectifier, Inverter and Dump Load System	
AC input range	According to the design
AC frequency range	According to the design
AC output	
Rated grid voltage (single phase/Three phase)	230/400
Operating range of AC power frequency	50 Hz (+0.5 Hz, -0.5 Hz)
Rated Output Voltage	400 V
Maximum Total Harmonic Distortion	4%
General	
Maximum Noise level	55 dB
Battery Bank	
Rated Voltage of a Cluster	48 V
Grid Forming Inverters	
Rated grid voltage	400/230 V
Rated frequency	50 Hz
Power Factor	1 to -1
Maximum Total Harmonic Distortion	4%
External diesel generator connection specification	
Rated voltage	230/400 V
Rated Frequency	50 Hz
Maximum Inrush Current for 10ms	2A
DC connection for battery specification	
Rated input voltage	According to the design
Battery Capacity Range	According to the design
Recommended Minimum Battery Capacity (C10) in Off grid System	According to the design
General specification	
Noise emission	less than 50dB(A)

For the purposes of evaluation, for each percentage point in performance or efficiency below the norm specified in the Specification but above the minimum acceptable levels also specified there, an adjustment of USD “Amount of Energy Unites x 0.4” will be added to the bid price.

1.3.5 Recommended Spare Parts

The price of recommended spare parts quoted in Price Schedule No. 6 shall not be considered for evaluation. The quantity of spare parts will be decided by the Employer.

1.3.6 Work, Services, Facilities, etc., to be provided by the Employer

NIL

1.3.7 Specific Additional Criteria

NIL

1.3.8 Domestic Preference

NIL

2. Qualification

It is the legal entity or entities comprising the Bidder, and not the Bidder's parent companies, subsidiaries, or affiliates, that must satisfy the qualification criteria described below.

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.1.1 Nationality					
Nationality in accordance with ITB Subclause 4.2.	must meet requirement	must meet requirement	must meet requirement	not applicable	Forms ELI - 1; ELI - 2 with attachments
2.1.2 Conflict of Interest					
No conflicts of interest in accordance with ITB Subclause 4.3.	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.3 Eligibility					
Not having been declared ineligible by ……, as described in ITB Subclause 4.4.	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid

2.2 Pending Litigation and Arbitration

Pending litigation and arbitration criterion shall apply.

2.2.1 Pending Litigation and Arbitration

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
All pending litigation and arbitration, if any, shall be treated as resolved against the Bidder and so shall in total not represent more than 70% percent of the Bidder's net worth calculated as the difference between total assets and total liabilities.	must meet requirement by itself or as partner to past or existing Joint Venture	not applicable	must meet requirement by itself or as partner to past or existing Joint Venture	not applicable	Form LIT - 1

2.3 Financial Situation

2.3.1 Historical Financial Performance

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Submission of audited financial statements or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last three (3) years to demonstrate the current soundness of the Bidder's financial position. As a minimum, the Bidder's net worth for the last year calculated as the difference between total assets and total liabilities should be positive.	must meet requirement	not applicable	must meet requirement	not applicable	Form FIN - 1 with attachments

2.3.2 Average Annual Turnover

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Minimum average annual turnover of $ 11 Million or equivalent amount in INR (for currency conversion, rate of 1 USD = 80.3 INR may be taken into account) calculated as total certified payments received for contracts in progress or completed, within the last three (3) years.	must meet requirement	must meet requirement	must meet 25% of the requirement	must meet 40% of the requirement	Form FIN - 2

2.3.3 Financial Resources

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
For Single Entities: The Bidder must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of USD 1.8 million.	must meet requirement	not applicable	not applicable	not applicable	Form FIN – 3 and Form FIN - 4
For Joint Ventures: (1) One partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of 40% from the total requirement for the Subject Contract. AND	not applicable	not applicable	not applicable	must meet requirement	Form FIN – 3 and Form FIN - 4
(2) Each partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of 25% from the total requirement for the Subject Contract. AND	not applicable	not applicable	must meet requirement	not applicable	Form FIN – 3 and Form FIN - 4
(3) The joint venture must demonstrate that the combined financial resources of all partners defined in FIN - 3, less all the partners' total financial obligations for the current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of USD 1.8 million.	not applicable	must meet requirement	not applicable	not applicable	Form FIN – 3 and Form FIN - 4

2.4 Bidder's Experience

2.4.1 Contracts of Similar Size and Nature

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Participation in at least one (1) contract for construction of Off-Grid Hybrid Renewable Energy System (HRES) of minimum generating capacity, 1000 kW that has been successfully or substantially completed within the last ten (10) years. The HRES shall comprises of Wind, Solar or a combination of Wind and Solar with minimum generating capacity of 700 kW and Diesel Generator (minimum capacity 300 kW) with a battery storage of minimum capacity 500 kWh (250 kW), and a control and monitoring system which is similar to the proposed contract, where the value of the Bidder's participation exceeds USD 5 million. The similarity of the Bidder's participation shall be based on the physical size, nature of works, complexity, methods, technology or other characteristics as described in Section 6 (Employer's Requirements).	must meet requirement	not applicable	not applicable	must meet requirement	Form EXP - 1

2.4.2 Experience in Key Activities

(Must be complied with by the Bidder. In case of a Joint Venture Bidder, at least one of the partners must have experience in the key activity. If the activity can be subcontracted, the requirement must be specified in criterion 2.5 of Section 3.)

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
For the above or other contracts executed during the period stipulated in 2.4.1 above, a minimum experience in the following key activities:	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Solar Experience; Design, supply, installation and commissioning of 3 off-grid Solar Plants of minimum capacity of each plant 1 MW	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Wind Experience; Design, supply, installation and commissioning of 3 Wind Plants and associated control system of minimum capacity of each plant 200 kW	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Diesel Generator Experience; Design, supply, installation and commissioning of 4 Diesel Generators of minimum capacity of each generator 250 kW	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Li-Ion/LFP Li-Ion/LFP Battery Experience; Design, supply, installation and commissioning of 3 Li-Ion/LFP Li-Ion/LFP battery systems of minimum capacity of 500 kWh (250 kW) and Associated Control System	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Grid Integration (Energy Management System) Experience 1; Design, supply, installation and commissioning of 3 off-Grid Energy Management Systems which manages Solar, Wind or a combination of Solar and Wind Combination with minimum generating capacity of each plant 700 kW integrated with Diesel (min capacity 300 kW) and Li-Ion/LFP Li-Ion/LFP Battery (min capacity 500 kWh) in one system.	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)
Grid Integration (Energy Management System) Experience 2; Design, supply, installation and commissioning of 3 Energy Management Systems which manages wind (min capacity of each plant 200kW) in one system.	must meet requirements	not applicable	not applicable	must meet requirements	Form EXP – 2(a)

2.5 Subcontractors

Subcontractors or Manufacturers for the following major items of plant and services must meet the following minimum criteria, herein listed for that item. Failure to comply with this requirement will result in rejection of the subcontractor but not the Bidder.

Item No.	Description of Item	Minimum Criteria to be met	Documents Submission Requirements
1	Sub-Contractor for Civil Works	Shall have minimum 10 years' experience in civil construction work and experience of a construction of a power plant building or similar work and construction of foundations for wind generators .	Form EXP-3
2	Sub-Contractor for Electrical Works	Shall have minimum of 10 years' experience in 400V and 11kV or above electrical installation work	
3	Manufacturers of Diesel Generator	Shall have minimum of 10 years manufacturing experience	
4	Manufacturers of Solar Panels and Accessories	Shall have minimum of 10 years manufacturing experience.	
5	Manufacturers of PV Inverters, Wind Inverters, Grid forming Inverters and Accessories	Shall have minimum of 05 years manufacturing experience.	
6	Manufacturers of Wind Generators, and Accessories	Shall have minimum of 10 years manufacturing experience.	
7	Manufacturers of Battery Banks and Accessories	Shall have minimum of 10 years manufacturing experience.	
8	Manufacturers of Grid Management System	Shall have minimum of 04 years manufacturing experience	
9	Manufacturers of transformers	Shall have minimum of 10 years manufacturing experience	

In the case of a Bidder who offers to supply and install major items of plant under the contract, which the Bidder did not manufacture or otherwise produce, the Bidder shall provide the Manufacturer's authorization, using the form provided in Section 4 (Bidding Forms), showing that the Bidder has been duly authorized by the Manufacturer or producer of the related plant and equipment or component to supply and install that item in the Employer's country. Failure to submit the Manufacturer's authorization at the first instance is considered a minor, nonmaterial omission and shall be subject to clarification. However, failure of the Bidder to submit the omitted authorization shall lead to rejection of the Subcontractor or Manufacturer of the item under evaluation in accordance with ITB 35.4.

Section 4 - Bidding Forms

This section contains the forms to be completed by the Bidder and submitted as part of its Bid.

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Letter of Technical Bid

-- Note –

The bidder must accomplish the Letter of Technical Bid on its letterhead clearly showing the bidder's complete name and address.

Date: .....

LCB No.: .....

Invitation for Bid No.: .....

To: [. . . *insert complete name of the employer* . . .]

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.

(b) We offer to design, manufacture, test, deliver, install, pre-commission, and commission in conformity with the Bidding Document the following Plant and Services: [. . . *insert narrative* . .
.]

(c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of [. . . *insert bid validity period as specified in ITB 20.1 of the BDS* . . .] days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(d) We, including any Subcontractors or Manufacturers for any part of the Contract, have or will have nationalities from eligible countries, in accordance with ITB 4.2.

(e) We, including any Subcontractors or Suppliers for any part of the Contract, do not have any conflict of interest in accordance with ITB 4.3.

(f) We are not participating, as a Bidder in more than one bid in this bidding process in accordance with ITB 4.3(e), other than alternative offers submitted in accordance with ITB 13.

(g) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible under clause ITB 4.3.

(h) [We are not a government-owned enterprise] / [We are a government-owned enterprise but meet the requirements of ITB 4.5].[1]

(i) We agree to permit GOI or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by them.

(j) If our Bid is accepted, we commit to mobilizing key equipment and personnel in accordance with the requirements set forth in Section 6 (Employer's Requirements) and our technical proposal, or as otherwise agreed with the Employer.

(k) If our bid is accepted, we (in our capacity as contractor) hereby agree that no assignment of this agreement shall be made whatsoever. Nothing under this provision shall be deemed to be giving us the right to transfer any of our legal obligation (as contractor) to perform under this agreement to any third party. We shall not subcontract the provision of the services or any obligation of the contractor constituting total work under this Agreement without obtaining prior approval from the Employer.

(l) If our bid is accepted, we (in our capacity as contractor) will settle claims/disputes, if any made by the subcontractors(s) through the due process as per the works contract signed between the contractor and subcontractors(s). the Employer will neither be a party to such disputes nor be liable for any damages/ claims arising from such disputes. The Employer will also not be liable for any other amounts considers as payable to the subcontractors(s) by us (in our capacity as contractor) arising out of the subcontractor's claims.

(m) We understand that you may cancel the qualification process at any time and that you are neither bound to accept any Application that you may receive nor to invite the qualified Applicants to bid for subsequent contract(s) subject to this qualification process, without incurring any liability to the Applicants.

(n) We hereby confirm that we have not appointed any agent and we have not paid any agency commission for this qualification process. If qualified, we also confirm that we will not appoint any agent and nor will we pay any agency commission for the corresponding tendering process or execution of the contract.

(o) All information, statements and description contained in the Application are in all respect true, correct and complete to the best of our knowledge and belief. We understand that misrepresentation of facts in our Application inter alia, may lead to rejection of our Application/cancellation of qualification.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

.....

[1] Use one of the two options as appropriate.

Letter of Price Bid

-- Note –

The bidder must accomplish the Letter of Price Bid on its letterhead clearly showing the bidder's complete name and address.

Date: .....

LCB No.: .....

Invitation for Bid No.: .....

To: [. . . *insert complete name of the employer* . . .]

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Document, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.

(b) We offer to design, manufacture, test, deliver, install, pre-commission, and commission in conformity with the Bidding Document the following Plant and Services: [. . . *insert narrative* . . .]

(c) The total price of our Bid, excluding any discounts offered in item (d) below is the sum of

[*amount of foreign currency in words*], [*amount in figures*], and [*amount of local currency in words*], [*amount in figures*]

The total bid price from the Grand Summary (Schedule No. 5) should be entered by the Bidder inside this box. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the bid.

(d) The discounts offered and the methodology for their application are as follows: [. . . *insert discounts and methodology for their application if any* . . .]

(e) Our Bid shall be valid for a period of [. . . *insert bid validity period as specified in ITB 20.1 of the BDS* . . .] days from the date fixed for the submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(f) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Document.

(g) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: [1]

Name of Recipient	Address	Reason	Amount
.....	.....	.....	.....
.....	.....	.....	.....

(h) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed.

(i) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

(j) We agree its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by GOSL.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

.....

[1] If none has been paid or is to be paid, indicate “None.”

Price Schedules

PREAMBLE

General

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

   Schedule No. 1: Plant and Mandatory Spare Parts Supplied from Abroad

   Schedule No. 2: Plant and Mandatory Spare Parts Supplied from within the Employer's Country

   Schedule No. 3: Design Services

   Schedule No. 4: Installation and Other Services

   Schedule No. 5: Grand Summary

   Schedule No. 6: Mandatory Spare Parts

   Schedule No. 7: Recommended Spare Parts

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. Bidders shall be deemed to have read the Employer's Requirements and other sections of the Bidding 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 Bidders are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITB 7 prior to submitting their bid.

Pricing

4. The units and rates in figures entered into the Price Schedules should be typewritten or if written by hand, must be in print form. Price Schedules not presented accordingly may be considered nonresponsive. Any alterations necessary due to errors, etc., shall be initialed by the Bidder.

   As specified in the Bid 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. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Bidders in the Bidding Document.

   For each item, Bidders 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 (Employer's Requirements) or elsewhere in the Bidding Document.

6. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.

7. When requested by the Employer for the purposes of making payments or part payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedules.

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 1: Plant and Mandatory Spare Parts Supplied from Abroad

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
(1-A) Supply of Material and Equipment for Plant in Nainativu Island							
Supply of PV Modules, PV Inverters and Accessories							
1A01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.		1 Unit				
1A02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.		1 Unit				
1A03	Supply and Delivery of Supporting Structures and tracking system for PV Modules		1 Unit				
Supply of Diesel Generators and Accessories							
1A04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories		1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories							
1A05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.		1 Unit				
1A06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.		1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories							
1A07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.		1 Unit				
1A08	Supply and of Delivery of mounting structures for Wind Turbines		1 Unit				
1A09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.		1 Unit				
1A10	Supply and Delivery of Dump Loads or Control Systems for Wind Turbines and any other accessories as required including switches,		1 Unit				

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
	wires, panels, fuses, surge arrestors etc.						
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories							
1A11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.		1 Unit				
1A12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.		1 Unit				
1A13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system		1 Unit				
1A14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.		1 Unit				
Supply Delivery and Installation of Grid Interconnection Point							
1A15	Supply and Delivery of transformers		1 Unit				
1A16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection		1 Unit				
1A17	Supply and Delivery of steel poles, cross arms, insulators, wires, material for concrete, etc.		1 Unit				
OTHER							
1A18	Supply and delivery of any other material required for completing the scope of work		1 Unit				
TOTAL Column 7 to be carried forward to Schedule No. 5: Grand Summary							

Name of Bidder _____

Signature of Bidder _____

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
(1-B) Supply of Material and Equipment for Plant in Analativu Island							
Supply of PV Modules, PV Inverters and Accessories							
1B01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.		1 Unit				
1B02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.		1 Unit				
1B03	Supply and Delivery of Supporting Structures and tracking system for PV Modules		1 Unit				
Supply of Diesel Generators and Accessories							
1B04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories		1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories							
1B05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.		1 Unit				
1B06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.		1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories							
1B07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.		1 Unit				
1B08	Supply and of Delivery of mounting structures for Wind Turbines		1 Unit				
1B09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.		1 Unit				
1B10	Supply and Delivery of Dump Loads or a Control Systems for Wind Turbines and any other accessories as required		1 Unit				

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
	including switches, wires, panels, fuses, surge arrestors etc.						
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories							
1B11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.		1 Unit				
1B12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.		1 Unit				
1B13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system		1 Unit				
1B14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.		1 Unit				
Supply Delivery and Installation of Grid Interconnection Point							
1B15	Supply and Delivery of transformers		1 Unit				
1B16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection		1 Unit				
1B17	Supply and Delivery of steel poles, cross arms, insulators, conductors, material for concrete, etc.		1 Unit				
OTHER							
1B18	Supply and delivery of any other material required for completing the scope of work		1 Unit				
TOTAL Column 7 to be carried forward to Schedule No. 5: Grand Summary							

Name of Bidder _____

Signature of Bidder

_____

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
(1-C) Supply of Material and Equipment for Plant in Delft Island							
Supply of PV Modules, PV Inverters and Accessories							
1C01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.		1 Unit				
1C02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.		1 Unit				
1C03	Supply and Delivery of Supporting Structures and tracking system for PV Modules		1 Unit				
Supply of Diesel Generators and Accessories							
1C04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories		1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories							
1C05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.		1 Unit				
1C06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.		1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories							
1C07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.		1 Unit				
1C08	Supply and of Delivery of mounting structures for Wind Turbines		1 Unit				
1C09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.		1 Unit				
1C10	Supply and Delivery of Dump Loads or Control Systems and Control Systems for Wind Turbines and any other accessories as required including switches, wires,		1 Unit				

Item	Description	Country of Origin	Quantity	Unit Price[a]		Total Price[a]	Taxes and Duties
				Foreign Currency	CIP to the Proposed Site	Foreign Currency	Local Currency
1	2	3	4	5	6	7= 4 x 6	8
	panels, fuses, surge arrestors etc.						
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories							
1C11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.		1 Unit				
1C12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.		1 Unit				
1C13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system		1 Unit				
1C14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.		1 Unit				
Supply Delivery and Installation of Grid Interconnection Point							
1C15	Supply and Delivery of transformers		1 Unit				
1C16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection		1 Unit				
1C17	Supply and Delivery of steel poles, cross arms, insulators, conductors, material for concrete, etc.		1 Unit				
OTHER							
1C18	Supply and delivery of any other material required for completing the scope of work		1 Unit				
TOTAL Column 7 to be carried forward to Schedule No. 5: Grand Summary							

Name of Bidder _____

Signature of Bidder _____

[a] *Specify currencies in accordance with ITB 19.1 of the BDS. Create additional columns for up to a maximum of three foreign currencies if so required.*

Country of Origin Declaration Form

Item	Description	Country
1.	PV Panels and accessories	
2.	PV Inverters	
3.	Wind Generator	
4.	Wind Inverter and accessories	
5.	Battery Banks and accessories	
6.	Grid forming Inverters	
7.	Diesel Generators and accessories	
8.	Grid Management System and accessories	
9.	Control Switching Box	
10.	Transformers and accessories	

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 2: Plant and Mandatory Spare Parts Supplied from Within the Employer's Country.

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
(2-A)	**Supply of Material and Equipment for Plant in Nainativu Island**					
Supply of PV Modules, PV Inverters and Accessories						
2A01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.	1 Unit				
2A02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.	1 Unit				
2A03	Supply and Delivery of Supporting Structures and tracking system for PV Modules	1 Unit				
Supply of Diesel Generators and Accessories						
2A04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories	1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories						
2A05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.	1 Unit				
2A06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.	1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories						
2A07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.	1 Unit				
2A08	Supply and of Delivery of mounting structures for Wind Turbines	1 Unit				
2A09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.	1 Unit				
2A10	Supply and Delivery of Dump Loads or Control Systems for Wind Turbines and any other accessories	1 Unit				

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
	as required including switches, wires, panels, fuses, surge arrestors etc.					
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories						
2A11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.	1 Unit				
2A12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.	1 Unit				
2A13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system	1 Unit				
2A14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.	1 Unit				
Supply Delivery and Installation of Grid Interconnection Point						
2A15	Supply and Delivery of transformers	1 Unit				
2A16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection	1 Unit				
2A17	Supply and Delivery of steel poles, cross arms, insulators, conductors, material for concrete, etc.	1 Unit				
OTHER						
2A18	Supply and delivery of any other material required for completing the scope of work	1 Unit				
	TOTAL Column 6 to be carried forward to Schedule No. 5: Grand Summary					

Name of Bidder _____

Signature of Bidder _____

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
(2-B) Supply of Material and Equipment for Plant in Analativu Island						
Supply of PV Modules, PV Inverters and Accessories						
2B01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.	1 Unit				
2B02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.	1 Unit				
2B03	Supply and Delivery of Supporting Structures and tracking system for PV Modules	1 Unit				
Supply of Diesel Generators and Accessories						
2B04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories	1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories						
2B05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.	1 Unit				
2B06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.	1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories						
2B07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.	1 Unit				
2B08	Supply and of Delivery of mounting structures for Wind Turbines	1 Unit				
2B09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.	1 Unit				
2B10	Supply and Delivery of Dump Loads or Control Systems for Wind Turbines and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.	1 Unit				

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories						
2B11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.	1 Unit				
2B12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.	1 Unit				
2B13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system	1 Unit				
2B14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.	1 Unit				
Supply Delivery and Installation of Grid Interconnection Point						
2B15	Supply and Delivery of transformers	1 Unit				
2B16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection	1 Unit				
2B17	Supply and Delivery of steel poles, cross arms, insulators, conductors, material for concrete, etc.	1 Unit				
OTHER						
2B18	Supply and delivery of any other material required for completing the scope of work	1 Unit				
	TOTAL Column 6 to be carried forward to Schedule No. 5: Grand Summary					

Name of Bidder _____

Signature of Bidder _____

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
(A) Supply of Material and Equipment for Plant in Delft Island						
Supply of PV Modules, PV Inverters and Accessories						
2C01	Supply and Delivery of PV Modules and any other accessories as required including switches, wires, junction diode boxes etc.	1 Unit				
2C02	Supply and Delivery of Photovoltaic Inverters and any other accessories as required including switches, wires, surge arrestors etc.	1 Unit				
2C03	Supply and Delivery of Supporting Structures and tracking system for PV Modules	1 Unit				
Supply of Diesel Generators and Accessories						
2C04	Supply and Delivery of Diesel Generators, control panels, switches, wires, and other accessories	1 Unit				
Supply of Battery Bank, Grid Forming Invertors and Accessories						
2C05	Supply and Delivery of Batteries and any other accessories as required including switches, wires, fuses etc.	1 Unit				
2C06	Supply and Delivery of Grid Forming Inverters and any other accessories as required including battery management system, switches, wires, surge arrestors etc.	1 Unit				
Supply of Wind Turbines, Wind Invertors and Accessories						
2C07	Supply and Delivery of Wind Turbines, and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.	1 Unit				
2C08	Supply and of Delivery of mounting structures for Wind Turbines	1 Unit				
2C09	Supply and of Delivery of Converters, Inverters for Wind Turbines and any other accessories as required including foundation bolts, plates, erection equipment etc.	1 Unit				
2C10	Supply and Delivery of Dump Loads or Control Systems for Wind Turbines and any other accessories as required including switches, wires, panels, fuses, surge arrestors etc.	1 Unit				

Item	Description	Quantity	Unit Price[a]		Total EXW Price[a]	Sales and Other Taxes
			Local Currency	EXW Price		
1	2	3	4	5	6= 3 x 5	7
Supply of Control Switch Box , Grid Management System and Controlling System, Interconnecting Cables, and Associated Other Accessories						
2C11	Supply and Delivery of Control Switch for the Proposed Plant and other accessories such as wires, fuses, switches, relays etc.	1 Unit				
2C12	Supply and Delivery of Grid management System for Proposed Plant and other accessories such as cables, remote monitoring equipment, communication faculties, consoles, etc. sensors for monitoring ambient temperature, etc.	1 Unit				
2C13	Supply and Delivery of meters, panels, wires required for measuring electric parameters of the system	1 Unit				
2C14	Supply and Delivery of equipment and accessories for construction of Weather Monitoring and Reporting System.	1 Unit				
Supply Delivery and Installation of Grid Interconnection Point						
2C15	Supply and Delivery of transformers	1 Unit				
2C16	Supply and Delivery of Breakers and Isolators, meters, equipment for grid interconnection	1 Unit				
2C17	Supply and Delivery of steel poles, cross arms, insulators, conductors, material for concrete, etc.	1 Unit				
OTHER						
2C18	Supply and delivery of any other material required for completing the scope of work	1 Unit				
	TOTAL Column 6 to be carried forward to Schedule No. 5: Grand Summary					

Name of Bidder _____

Signature of Bidder _____

a Specify currency in accordance with ITB 19.1 of the BDS.

b Column 5 EXW Price shall include all customs duties and sales and other taxes already paid or payable on the components and raw materials used in the manufacture or assembly of the item or the customs duties and sales and other taxes already paid on previously imported items.

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 3: Design Services

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
(1)	**Plant in Nainativu Island**					
(a)	Designing of hybrid energy system to comply with the requirements given in Bid Document and submission of drawings, and reports.	1 Unit				
(b)	Design of Civil Works including Building, Mounting Structures, foundations, drainage system etc. and submission of drawings, and reports.	1 Unit				
(c)	Design of Mechanical and Electrical Works of power plant building and submission of drawings, and reports.	1 Unit				
(d)	Providing hybrid system design software licenced to IA until the completion of the project	1 Unit				
(e)	Total Weather Stations	1 Unit				
(f)	Any other design required for the completion of the project scope	1 Unit				
TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary						
(2)	**Plant in Analativu Island**					
(a)	Designing of hybrid energy system to comply with the requirements given in Bid Document and submission of drawings, and reports.	1 Unit				
(b)	Design of Civil Works including Building, Mounting Structures, foundations, drainage system etc. and submission of drawings, and reports.	1 unit				
(c)	Design of Mechanical and Electrical Works of power plant building and submission of drawings, and reports.	1 Unit				
(d)	Providing hybrid system design software licensed to IA until the completion of the project	1 Unit				
(e)	Total Weather Stations	1 Unit				
(f)	Any other design required for the completion of the project scope	1 Unit				
TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary						

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
(3)	**Plant in Delft Island**					
(a)	Designing of hybrid energy system to comply with the requirements given in Bid Document and submission of drawings, and reports.	1 Unit				
(b)	Design of Civil Works including Building, Mounting Structures, foundations, drainage system etc. and submission of drawings, and reports.	1 unit				
(c)	Design of Mechanical and Electrical Works of power plant building and submission of drawings, and reports.	1 Unit				
(d)	Providing hybrid system design software licensed to IA until the completion of the project	1 Unit				
(e)	Total Weather Stations	1 Unit				
(f)	Any other design required for the completion of the project scope	1 Unit				
	TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary					

Name of Bidder _____

Signature of Bidder _____

[a] *Specify currency in accordance with ITB 19.1 of the BDS.*

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 4 - Installation and Other Services

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
(1) Plant in Nainativu Island						
(a) Civil Works						
1.	Clearing and Transporting all material listed in Annex-C7 to the site	1 Unit				
2.	Construction and maintenance of temporary buildings for protection and storage of materials	1 Unit				
3.	Construction and maintenance of temporary buildings for contractor's and Engineer's offices	1 Unit				
4.	Sanitary facilities for workmen and employers' staff	1 Unit				
5.	Construction management services as per bidding document	1 Unit				
6.	Providing necessary Test reports for the construction works.	1 Unit				
7.	Providing necessary protective fencing and hoarding and making preventive measures to restrain environment pollution	1 Unit				
8.	Erection of Name Board as per the details submitted by the Engineer	1 Unit				
9.	Site surveying, land preparation, backfilling and clearing	1 Unit				
10.	Wind mill foundations construction	1 Unit				
11.	Wind mill erections	1 Unit				
12.	Foundation work for all building walls and columns including excavations	1 Unit				
13.	Design and built mounting structure for PV panels except for the panels to be installed on building roofs	1 Unit				
14.	Construction of floor slabs for generators as per Annex C4	1 Unit				
15.	Construction floor slabs for control and battery room and other areas and in all other buildings where necessary.	1 Unit				
16.	Floor tiling of the executive quarters and power plant building except generator room.	1 Unit				
17.	Wall tiling of washrooms of All buildings as Annex C	1 Unit				
18.	Construction of generator floor & pavement of the building and paving of floors in labour quarters, security office and pavement of supervisory staff quarters	1 Unit				
19.	brick work for all buildings as Annex C	1 Unit				

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
20.	Providing and fixing Doors & windows for all Buildings as Annex C(Aluminum)	1 Unit				
21.	Roof works for all Buildings including preparation for laying PV panels on top of building roofs where necessary	1 Unit				
22.	Roof ceiling for all buildings as Annex C	1 Unit				
23.	Finishing of all buildings (Internal & External plastering & painting)	1 Unit				
24.	Construction of cable trenches	1 Unit				
25.	Wiring and provide lamps for all building, air conditioning for battery room and executive quarters and exhaust fans for PV rooms	1 Unit				
26.	Water supply system, internal & external plumbing & sewerage system	1 Unit				
27.	Construction of Chain link fence, gate house and supply and fixing a gate	1 Unit				
28.	Storm water drainage system	1 Unit				
29.	Construction of Internal roads & access roads	1 Unit				
30.	Furnishing and supplying of all necessary furniture for all buildings as stated in Annex C10	1 Unit				
31.	Removal of all rubbish and debris and clearing up site on completion and handing over	1 Unit				
32.	Any other required construction for the completeness of the work as mentioned below.	1 Unit				
(b)	**Mechanical and Electrical Installation**					
1.	Installation of Diesel Generator control / protection panels, cabling work and testing and commissioning	2 Units				
2.	Installation of Wind Generators, control / protection panels, inverter, cabling work and testing and commissioning	1 Lot				
3.	Installation of Battery bank, Control Switch Box, Grid forming inverter set, control and protection panels, cabling work and testing and commissioning	1 Unit				
4.	Installation of PV panels, control / protection panels, inverters and cabling work in pergolas building, testing and commissioning	1 Unit				
5.	Installation of PV panels, control / protection panels, inverters and cabling work in Power plant roof, testing and commissioning	1 Unit				
6.	Installation of Diesel Generator control / protection panels , cabling work and testing and commissioning	1 Unit				

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
7.	Any other required electrical and mechanical work for the completeness of the work as mentioned bellow.	1 Unit				
(c)	**Testing and Commissioning**					
1.	Dynamic Cone Penetration Tests as required	1 Unit				
2.	Borehole soil tests as required by the soil condition	1 Unit				
3.	Earth foot impedance measurement of wind mills	1 Unit				
4.	Conductor joint verification with thermal Images	1 Unit				
5.	Testing and commissioning of; Wind System PV System Diesel Generator Battery Bank Monitoring and Controlling System Weather station Complete Plant	1 Unit				
	TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary					

Name of Bidder _____

Signature of Bidder _____

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
(2) Plant in Analativu Island						
(a) Civil Works						
1.	Clearing and Transporting all material listed in Annex-C7 to the site	1 Unit				
2.	Construction and maintenance of temporary buildings for protection and storage of materials	1 Unit				
3.	Construction and maintenance of temporary buildings for contractor's and Engineer's offices	1 Unit				
4.	Sanitary facilities for workmen and employers' staff	1 Unit				
5.	Construction management services as per bidding document	1 Unit				
6.	Providing necessary Test reports for the construction works.	1 Unit				
7.	Providing necessary protective fencing and hoarding and making preventive measures to restrain environment pollution	1 Unit				
8.	Erection of Name Board as per the details submitted by the Engineer	1 Unit				
9.	Site surveying, land preparation, backfilling and clearing	1 Unit				
10.	Wind mill foundations construction	1 Unit				
11.	Wind mill erections	1 Unit				
12.	Foundation work for all building walls and columns including excavations	1 Unit				
13.	Design and built mounting structure for PV panels except for the panels to be installed on building roofs	1 Unit				
14.	Construction of floor slabs for generators as per Annex C4	1 Unit				
15.	Construction floor slabs for control and battery room and other areas and in all other buildings where necessary.	1 Unit				
16.	Floor tiling of the executive quarters and power plant building except generator room.	1 Unit				
17.	Wall tiling of washrooms of All buildings as Annex C	1 Unit				
18.	Construction of generator floor & pavement of the building and paving of floors in labour quarters, security office and pavement of supervisory staff quarters	1 Unit				
19.	brick work for all buildings as Annex C	1 Unit				
20.	Providing and fixing Doors & windows for all Buildings as Annex C(Aluminum)	1 Unit				
21.	Roof works for all Buildings including preparation for laying PV panels on top of building roofs where necessary	1 Unit				
22.	Roof ceiling for all buildings as Annex C	1 Unit				

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
23.	Finishing of all buildings (Internal & External plastering & painting)	1 Unit				
24.	Construction of cable trenches	1 Unit				
25.	Wiring and provide lamps for all building, air conditioning for battery room and executive quarters and exhaust fans for PV rooms	1 Unit				
26.	Water supply system, internal & external plumbing & sewerage system	1 Unit				
27.	Construction of Chain link fence, gate house and supply and fixing a gate	1 Unit				
28.	Storm water drainage system	1 Unit				
29.	Construction of Internal roads & access roads	1 Unit				
30.	Furnishing and supplying of all necessary furniture for all buildings as stated in Annex C10	1 Unit				
31.	Removal of all rubbish and debris and clearing up site on completion and handing over	1 Unit				
32.	Any other required construction for the completeness of the work as mentioned below.	1 Unit				
(b) Mechanical and Electrical Installation						
1.	Installation of Diesel Generator control / protection panels, cabling work and testing and commissioning	2 Units				
2.	Installation of Wind Generators, control / protection panels, inverter, cabling work and testing and commissioning	1 Lot				
3.	Installation of Battery bank, Control Switch Box, Grid forming inverter set, control and protection panels, cabling work and testing and commissioning	1 Unit				
4.	Installation of PV panels, control / protection panels, inverters and cabling work in pergolas building, testing and commissioning	1 Unit				
5.	Installation of PV panels, control / protection panels, inverters and cabling work in Power plant roof, testing and commissioning	1 Unit				
6.	Installation of Diesel Generator control / protection panels , cabling work and testing and commissioning	1 Unit				
7.	Any other required electrical and mechanical work for the completeness of the work as mentioned bellow.	1 Unit				
(c) Testing and Commissioning						
1.	Dynamic Cone Penetration Tests as required	1 Unit				

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
2.	Borehole soil tests as required by the soil condition	1 Unit				
3.	Earth foot impedance measurement of wind mills	1 Unit				
4.	Conductor joint verification with thermal Images	1 Unit				
5.	Testing and commissioning of; Wind System PV System Diesel Generator Battery Bank Monitoring and Controlling System Weather station Complete Plant	1 Unit				
	TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary					

Name of Bidder _____

Signature of Bidder _____

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
(3) Plant in Delfts Island						
(a) Civil Works						
1.	Clearing and Transporting all material listed in Annex-C7 to the site	1 Unit				
2.	Construction and maintenance of temporary buildings for protection and storage of materials	1 Unit				
3.	Construction and maintenance of temporary buildings for contractor's and Engineer's offices	1 Unit				
4.	Sanitary facilities for workmen and employers' staff	1 Unit				
5.	Construction management services as per bidding document	1 Unit				
6.	Providing necessary Test reports for the construction works.	1 Unit				
7.	Providing necessary protective fencing and hoarding and making preventive measures to restrain environment pollution	1 Unit				
8.	Erection of Name Board as per the details submitted by the Engineer	1 Unit				
9.	Site surveying, land preparation, backfilling and clearing	1 Unit				
10.	Wind mill foundations construction	1 Unit				
11.	Wind mill erections	1 Unit				
12.	Foundation work for all building walls and columns including excavations	1 Unit				
13.	Design and built mounting structure for PV panels except for the panels to be installed on building roofs	1 Unit				
14.	Construction of floor slabs for generators as per Annex C4	1 Unit				
15.	Construction floor slabs for control and battery room and other areas and in all other buildings where necessary.	1 Unit				
16.	Floor tiling of the executive quarters and power plant building except generator room.	1 Unit				
17.	Wall tiling of washrooms of All buildings as Annex C	1 Unit				
18.	Construction of generator floor & pavement of the building and paving of floors in labour quarters, security office and pavement of supervisory staff quarters	1 Unit				
19.	brick work for all buildings as Annex C	1 Unit				
20.	Providing and fixing Doors & windows for all Buildings as Annex C(Aluminum)	1 Unit				
21.	Roof works for all Buildings including preparation for laying PV panels on top of building roofs where necessary	1 Unit				
22.	Roof ceiling for all buildings as Annex C	1 Unit				

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
23.	Finishing of all buildings (Internal & External plastering & painting)	1 Unit				
24.	Construction of cable trenches	1 Unit				
25.	Wiring and provide lamps for all building, air conditioning for battery room and executive quarters and exhaust fans for PV rooms	1 Unit				
26.	Water supply system, internal & external plumbing & sewerage system	1 Unit				
27.	Construction of Chain link fence, gate house and supply and fixing a gate	1 Unit				
28.	Storm water drainage system	1 Unit				
29.	Construction of Internal roads & access roads	1 Unit				
30.	Furnishing and supplying of all necessary furniture for all buildings as stated in Annex C10	1 Unit				
31.	Removal of all rubbish and debris and clearing up site on completion and handing over	1 Unit				
32.	Any other required construction for the completeness of the work as mentioned below.	1 Unit				
(b)	**Mechanical and Electrical Installation**					
1.	Installation of Diesel Generator control / protection panels, cabling work and testing and commissioning	2 Units				
2.	Installation of Wind Generators, control / protection panels, inverter, cabling work and testing and commissioning	1 Lot				
3.	Installation of Battery bank, Control Switch Box, Grid forming inverter set, control and protection panels, cabling work and testing and commissioning	1 Unit				
4.	Installation of PV panels, control / protection panels, inverters and cabling work in pergolas building, testing and commissioning	1 Unit				
5.	Installation of PV panels, control / protection panels, inverters and cabling work in Power plant roof, testing and commissioning	1 Unit				
6.	Installation of Diesel Generator control / protection panels , cabling work and testing and commissioning	1 Unit				
7.	Any other required electrical and mechanical work for the completeness of the work as mentioned bellow.	1 Unit				
(c)	**Testing and Commissioning**					
1.	Dynamic Cone Penetration Tests as required	1 Unit				

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7= 3 x 5
2.	Borehole soil tests as required by the soil condition	1 Unit				
3.	Earth foot impedance measurement of wind mills	1 Unit				
4.	Conductor joint verification with thermal Images	1 Unit				
5.	Testing and commissioning of; Wind System PV System Diesel Generator Battery Bank Monitoring and Controlling System Weather station Complete Plant	1 Unit				
	TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary					

Name of Bidder _____

Signature of Bidder _____

Item	Description	Qty.	Unit Price[a]		Total Price[a]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	8 = 3 x 5
(4) Other Services						
(a) Providing Training, Accommodation, Transport and Communication						
1.	Providing all Training modules in accordance with clause 1.7.2 of Chapter 1, Part B, Section 6	1 Unit				
2.	Providing accommodation for employers in accordance with clause 1.7.1 (a) of Chapter 1, Part B, Section 6	1 Unit				
3.	Cost of Providing Transport for employer in accordance with clause 1.7.1 (d) of Chapter 1, Part B, Section 6	1 Unit				
4.	Providing off road four wheel driven double cabs in accordance with clause 1.7.1 (d) of Chapter 1, Part B, Section 6	2 Nos				
6.	Providing Transport for employer in accordance with clause 1.7.1 (d) of Chapter 1, Part B, Section 6	1 Unit				
7.	Providing Communication facilities for employer in accordance with clause 1.7.1 (g) of Chapter 1, Part B, Section 6	1 Unit				
(b) Factory Acceptance testing						
1.	Witnessing of factory acceptance testing of PV Modues, PV Inverter, Diesel Generator and accessories, Battery Banks, Grid forming Inverters, Wind Generators, Wind Inverters, Control Switch Box, etc.	1 Unit				
TOTAL Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary						

Name of Bidder _____

Signature of Bidder _____

a Specify currency in accordance with ITB 19.1 of the BDS.

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 5 - Grand Summary

Schedule No.	Title	Total Price [a]	
		Foreign	Local
(1) Plant in Nainativu Island			
1	Plant and Mandatory Spare Parts Supplied from Abroad [b]		
2	Plant and Mandatory Spare Parts Supplied from Within the Employer's Country [b]		
3	Design Services		
4	Installation		
	Sub Total for proposal (i)		
(2) Plant in Analativu Island			
1	Plant and Mandatory Spare Parts Supplied from Abroad [b]		
2	Plant and Mandatory Spare Parts Supplied from Within the Employer's Country [b]		
3	Design Services		
4	Installation		
	Sub Total for proposal (ii)		
(3) Plant in Delft Island			
1	Plant and Mandatory Spare Parts Supplied from Abroad [b]		
2	Plant and Mandatory Spare Parts Supplied from Within the Employer's Country [b]		
3	Design Services		
4	Installation		
	Sub Total for proposal (iii)		
4 (A)	Other Services		
	GRAND TOTAL to be carried forward to Letter of Bid		

Name of Bidder _____

Signature of Bidder _____

[a] *Specify currency in accordance with ITB 19.1 of the BDS. Create additional columns for up to a maximum of three foreign currencies if so required.*

[b] *Taxes and/or duties from Schedules 1 and 2 may be added to the contract price in accordance with GCC 14 (Taxes and Duties) but excluded from bid evaluation in accordance with ITB 39.2.*

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 6: Mandatory Spare Parts

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			EXW Local Parts Local Currency	CIP Imported Parts Foreign Currency	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
1.	PV Panels	30				
2.	PV Inverters	3				
3.	Wind Inverter or Generator	3				
4.	Grid forming Inverters	3				
5.	Transformers (maximum capacity of all designed)	1				
6.	A portable computer	3				
7.	Following items in quantities for each diesel generator supplied shall be provided Fuel oil filters Air filters Engine oil filters Overhauling Kit Auto and Manual Synchronize panel	 5 5 5 1 1				
8.	A tool set necessary for Repair/Maintenance activities of the plant (PV, Diesel Gen, Inverter, Battery, Safety instruments)	1				
9.	A set of protective equipment necessary for operation and maintenance of the plant	1				
				TOTAL		

Name of Bidder _____

Signature of Bidder _____

[a] *Specify currency in accordance with ITB 19.1 of the BDS.*

HYBRID RENEWABLE ENERGY SYSTEMS IN THREE SMALL ISLANDS OF JAFFNA

SCHEDULES OF RATES AND PRICES

Schedule No. 7: Recommended Spare Parts

Item	Description	Quantity	Unit Price[a]		Total Price[a]	
			EXW Local Parts Local Currency	CIP Imported Parts Foreign Currency	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
				TOTAL		

Name of Bidder _____

Signature of Bidder _____

[a] *Specify currency in accordance with ITB 19.1 of the BDS.*

Tables of Adjustment Data

Table A - Local Currency

Concrete Works					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Cement				c: _____ d: _____
N_0	Reinforced Steel				
			Total		**1.00**

Table B - Foreign Currency

Name of Currency: _____

Diesel Generator					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Material 1				c: _____ d: _____
N_0	Material 1				
			Total		**1.00**

Wind Generator					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Material 1				c: _____ d: _____
N_0	Material 1				
			Total		**1.00**

PV Panels					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Material 1				c: _____ d: _____
N_0	Material 1				
			Total		**1.00**

Battery Banks					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Material 1				c: _____ d: _____
N_0	Material 1				
			Total		**1.00**

Inverters					
Index Code	**Index Description**	**Source of Index**	**Base Value and Date**	**Bidder's Local Currency Amount**	**Bidder's Proposed Weighting**
L_0	Labour Index				a: _____ b: _____
M_0	Material 1				c: _____ d: _____
N_0	Material 1				
			Total		**1.00**

- Note -

The base date shall be the date 28 days prior to the deadline for submission of the bid.

Tables of Adjustment Data shall only be included if prices are to be quoted as adjustable prices in accordance with ITB 18.6.

Bid Security

Bank Guarantee

.....Bank's name, and address of issuing branch or office[1]*.....*

Beneficiary: ..... *Name and address of the employer* .....

Date:.....

Bid Security No.: .....

We have been informed that . . . . . *name of the bidder*.....(hereinafter called "the Bidder") has submitted to you its bid dated . . . . . (hereinafter called "the Bid") for the execution of . . . . . *name of contract* . . . . . under Invitation for Bids No..... ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we . . . . . *name of Bank*..... hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . *.amount in words* . . . . . (. . . . . *.amount in figures*.....) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn its Bid during the period of bid validity specified by the Bidder in the Letters of Technical and Price Bid; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or

(c) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB.

This guarantee will expire (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the Performance Security issued to you upon the instruction of the Bidder; or (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy of your notification to the Bidder of the name of the successful Bidder, or (ii) 28 days after the expiration of the Bidder's bid.

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

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.[2]

. . . . . *Authorized signature(s) and bank's seal (where appropriate)* . . . . . .

-- Note –

In case of a joint venture, the bid security must be in the name of all partners to the joint venture that submits the bid.

[1] All italicized text is for use in preparing this form and shall be deleted from the final document.

[2] Or 758 as applicable.

Technical Proposal

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Plant

Personnel

Equipment

Proposed Subcontractors for Major Items of Plant and Services

Manufacturer's Authorization

Time Schedule – Alternative Time Schedules are not allowed in ITB 13.1

Functional Guarantee of the Proposed Facilities

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Plant

Personnel

Form PER – 1: Proposed Personnel

Bidders should provide the details of proposed personnel and their experience record in the relevant Information Forms below for each of the candidate, as indicated in Section 6 (Employer's Requirment).

1.	**Title of position***
	Name
2.	**Title of position***
	Name
3.	**Title of position***
	Name
4.	**Title of position***
	Name
etc.	**Title of position***
	Name

-- Note --

** As listed in Section 6 (Employer's Requirements).*

Form PER – 2: Resume of Proposed Personnel

The Bidder shall provide all the information requested below. Use one form for each position.

Position		
Personnel information	**Name**	**Date of birth**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager/personnel officer)**
	Fax	**E-mail**
	Job title	**Years with present employer**

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

From	To	Company/Project/Position/Relevant Technical and Management Experience

Equipment

Form EQU: Equipment

The Bidder shall provide adequate information and details to demonstrate clearly that it has the capability to meet the equipment requirements indicated in Section 6 (Employer's Requirements), using the Forms below. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

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 Bidder.

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

Proposed Subcontractors and/or Manufacturers for Major Items of Plant and Services

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

Major Items of Plant and Services	Proposed Subcontractors or Manufacturers	Nationality

Manufacturer's Authorization

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

LCB No.: *[insert number of bidding process]*

To: *[insert complete name of the employer]*

WHEREAS

We *[insert complete name of the manufacturer or manufacturer's authorized agent]*, who are official manufacturers or agent authorized by the Manufacturer of *[insert type of goods manufactured]*, having factories at *[insert full address of manufacturer's factories]*, do hereby authorize *[insert complete name of the bidder]* to submit a bid the purpose of which is to provide the following goods, manufactured by us *[insert name and/or brief description of the goods]*, and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty in accordance with Clause 27 of the General Conditions of Contract, with respect to the goods offered by the above firm.

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

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

Title: *[insert title]*

Duly authorized to sign this Authorization on behalf of *[insert complete name of the manufacturer]*

Dated on _____ day of _____, _____ *[insert date of signing]*

-- Note --

The bidder shall require the manufacturer to fill out this form in accordance with the instructions indicated. This letter of authorization should be signed by a person with the proper authority to sign documents that are binding on the manufacturer. The bidder shall include it in its bid, if so indicated in the BDS.

Time Schedule

Functional Guarantee of the Proposed Facilities

Form FUNC

The Bidder shall copy on the left column of the table below, the identification of each functional guarantee required in the Specification and stated by the Employer in EQC 1.3.4 of Section 3, Evaluation and Qualification Criteria, and on the right column, provide the corresponding value for each functional guarantee of the proposed plant and equipment.

Functional Guarantee	Functional Guarantee Value Offered by the Bidder		
Diesel Generator			
Islands	**Nainativu**	**Delft**	**Analativu**
Generator Prime Capacities			
Rated Frequency			
Rated Output Voltage			
Rated Speed			
Electrical Parameters			
Total Harmonic Distortion			
AVR self-regulated, voltage regulation rate			
Other			
Steady voltage regulation			
Noise Level			
PV Panels			
Maximum Power of a PV module at STC conditions (Pmax) – Calculated With correction factors			
Maximum Weight of a PV Panel			
Maximum output fault current			
Solar Inverter			
DC input			
Maximum DC input			
AC output			
Rated grid voltage (single phase/Three phase)			
Rated Output Frequency			
Power factor			
Maximum Total Harmonic Distortion			
General			
Maximum Allowable Noise level			
Wind Generator			
rated Output Voltage of the Generator			
Cut in Speed of WTG?			
Maximum Noise Level measured in Accordance with IEC 61400-1			
Rectifier, Inverter and Dump Load System			
AC input range			
AC frequency range			
AC output			

Rated grid voltage (single phase/Three phase)	
Operating range of AC power frequency	
Rated Output Voltage	
Maximum Total Harmonic Distortion	
General	
Maximum Noise level	
Battery Bank	
Rated Voltage of a Cluster	
Grid Forming Inverters	
Rated grid voltage	
Rated frequency	
Power Factor	
Maximum Total Harmonic Distortion	
External diesel generator connection specification	
Rated voltage	
Rated Frequency	
Maximum Inrush Current for 10ms	
DC connection for battery specification	
Rated input voltage	
Battery Capacity Range	
General specification	
Noise emission	
Auto and Manual Synchronize Panel	

Bidder's Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
In case of a Joint Venture, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone number(s), fax number(s), e-mail address)	

Attached are copies of the following documents:.

- ❑ 1. In case of a single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2
- ❑ 2. Authorization to represent the firm or Joint Venture named above, in accordance with ITB 22.2
- ❑ 3. In case of a Joint Venture, a letter of intent to form a Joint Venture or Joint Venture agreement, in accordance with ITB 4.1
- ❑ 4. In case of a government-owned enterprise, any additional documents not covered under 1 above required to comply with ITB 4.5

Form ELI - 2: Joint Venture Information Sheet

Each member of the Joint Venture must fill out this form separately. Subcontractor must fill out this form.

Joint Venture/Subcontractor Information	
Bidder's legal name	
Joint Venture Partner's or Subcontractor's legal name	
Joint Venture Partner's or Subcontractor's country of constitution	
Joint Venture Partner's or Subcontractor's year of constitution	
Joint Venture Partner's or Subcontractor's legal address in country of constitution	
Joint Venture Partner's or Subcontractor's authorized representative information (name, address, telephone number(s), fax number(s), e-mail address)	
Attached are copies of the following documents: ❑ 1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2 ❑ 2. Authorization to represent the firm named above, in accordance with ITB 22.2 ❑ 3. In the case of a government-owned enterprise, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5	

Subcontractors are those listed in Technical Proposal – Proposed Subcontractors and/or Manufacturers for Major Items of Plant and Services.

Form LIT – 1: Pending Litigation and Arbitration

Each Bidder must fill out this form if so required under Criterion 2.2 of Section 3 (Evaluation and Qualification Criteria) to describe any pending litigation or arbitration formally commenced against it.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Pending Litigation and Arbitration

Choose one of the following:

❑ No pending litigation and arbitration.

❑ Below is a description of all pending litigation and arbitration against the Bidder (or each Joint Venture member if Bidder is a Joint Venture).

Year	Matter in Dispute	Value of Pending Claim in $ Equivalent	Value of Pending Claim as a Percentage of Net Worth

- Note -

This form shall only be included if Criterion 2.2 of Section 3 (Evaluation and Qualification Criteria) is applicable.

Form FIN - 1: Historical Financial Performance

Each Bidder must fill out this form.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Financial Data for Previous ..... Years [$ Equivalent]		
Year 1:	**Year 2:**	**Year __:**

Information from Balance Sheet

Total Assets (TA)			
Total Liabilities (TL)			
Net Worth = TA-TL			
Current Assets (CA)			
Current Liabilities (CL)			
Working Capital = CA - CL			

Most Recent Working Capital		To be obtained for most recent year and carried forward to FIN - 3 Line 1; in case of Joint Ventures, to the corresponding Joint Venture Partner's FIN – 3.

Information from Income Statement

Total Revenues			
Profits Before Taxes			
Profits After Taxes			

❑ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last _____ years, as indicated above, complying with the following conditions.

- Unless otherwise required by Section 3 of the Bidding Documents, all such documents reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries or affiliates.
- Historical financial statements must be audited by a certified accountant.
- Historical financial statements must be complete, including all notes to the financial statements.
- Historical financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Turnover

Each Bidder must fill out this form.

The information supplied should be the Annual Turnover of the Bidder or each member of a Joint Venture in terms of the amounts billed to clients for each year for work in progress or completed, converted to US dollars at the rate of exchange at the end of the period reported.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Annual Turnover Data for the Last..... Years			
Year	**Amount Currency**	**Exchange Rate**	**$ Equivalent**
		Average Annual Turnover	

Form FIN – 3: Availability of Financial Resources

Bidders must demonstrate sufficient financial resources, usually comprising of Working Capital supplemented by credit line statements or overdraft facilities and others to meet the Bidder's financial requirements for

(a) its current contract commitments, and

(b) the subject contract.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Financial Resources		
No.	**Source of financing**	**Amount ($ equivalent)**
1	Working Capital (to be taken from FIN - 1)	
2	Credit Line[a]	
3	Other Financial Resources	
	Total Available Financial Resources	

[a] *To be substantiated by a letter from the bank issuing the line of credit.*

Form FIN- 4: Financial Requirements for Current Contract Commitments

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

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Current Contract Commitments						
No.	**Name of Contract**	**Employer's Contact (Address, Tel, Fax)**	**Contract Completion Date**	**Outstanding Contract Value (X) [a]**	**Remaining Contract Period in months (Y) [b]**	**Monthly Financial Resources Requirement (X / Y)**
1						
2						
3						
4						
Total Monthly Financial Requirement for Current Contract Commitments						**$** . . . . .

[a] *Remaining outstanding contract values to be calculated from 28 days prior to the bid submission deadline ($ equivalent based on the foreign exchange rate as of the same date).*

[b] *Remaining contract period to be calculated from 28 days prior to bid submission deadline.*

Form FIN - 5: Self-Assessment Tool for Bidder's Compliance to Financial Resources (Criterion 2.3.3 of Section 3)

This form requires the same information submitted in Forms FIN - 3 and FIN - 4. All conditions of "Available Financial Resources Net of CCC ≥ Requirement for the Subject Contract" must be satisfied to qualify.

Form FIN - 5A: For Single Entities

For Single Entities: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
_____ (Name of Bidder)				. . . . .	

Form FIN - 5B: For Joint Ventures

For Joint Ventures: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
One Partner:					
_____ (Name of Partner)				. . . . .	
Each Partner:					
_____ (Name of Partner 1)				. . . . .	
_____ (Name of Partner 2)				. . . . .	
_____ (Name of Partner 3)				. . . . .	
All partners combined	∑ D = Sum of available financial resources net of current contract commitments for all partners		∑ D = _____	. . . . .	

- Note -

Form FIN – 5 is made available for use by the bidder as a self-assessment tool, and by the employer as an evaluation work sheet, to determine compliance with the financial resources requirement as stated in 2.3.3. Failure to submit Form FIN - 5 by the Bidder shall not lead to bid rejection.

Form EXP – 1: Contracts of Similar Size and Nature

Fill out one (1) form per contract.

Contract of Similar Size and Nature			
Contract No . . . . . **of**	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**$**
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's name **Address** **Telephone number** **Fax number** **E-mail**			

Description of the Similarity in Accordance with Criterion 2.4.1 of Section 3 (Evaluation and Qualification Criteria)	

Form EXP - 2: Experience in Key Activities

Fill out one (1) form per contract.

Contract with Similar Key Activities			
Contract No . . . . . **of**	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**$**
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's name **Address** **Telephone number** **Fax number** **E-mail**			
Description of the Key Activities in Accordance with Criterion 2.4.2 of Section 3 (Evaluation and Qualification Criteria)			

Form EXP - 3: Subcontractors

Fill out one (1) form per contract.

Contract for the Major Items			
Contract No . . . . . **of**	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**$**
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's name **Address** **Telephone number** **Fax number** **E-mail**			

Description of the Major Items in Accordance with Criterion 2.5 of Section 3 (Evaluation and Qualification Criteria)	

Section 5 - Eligible Country

Only India is eligible for this procurement.

PART 2 – Supply Requirements

Section 6 – Employer's Requirement

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Part A-Scope of Supply of Plants and Services

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Scope of Supply of Plants and Services

1.0 General Description of the Project

The objective of this section of the document is to define the technical requirements of the project for Design, Supply and Installation of three Wind-Solar-Diesel Hybrid Systems (Plants) that are based on Photovoltaic, Wind Power, Diesel generator and Lithium-Ion storage batteries at three islands of Sri Lanka namely Nainativu, Analativu and Delft. Presently, those Islands are electrified using Diesel Generators. This project is to generate electricity in these Islands with hybrid power Plants.

Capacities of PV, wind and Diesel sources with the battery storage corresponding to the optimum generation mix have already been defined for each island and presented in the table below.

Island	Diesel generators	PV generation	Wind generation	Battery storage
Nainativu	300kW+500kW	700kW	200kW	1000kWh (550kW)
Analativu	150kW+300kW	300kW	80kW	550kWh (275kW)
Delft	300kW+500kW	700kW	250kW	800kWh (650kW)

All above mentioned capacities are measured at 400V busbar.

The interconnection among the different Plants (PV plant, wind power, battery and genset) should be carried out through an AC bus, according to the following configuration:

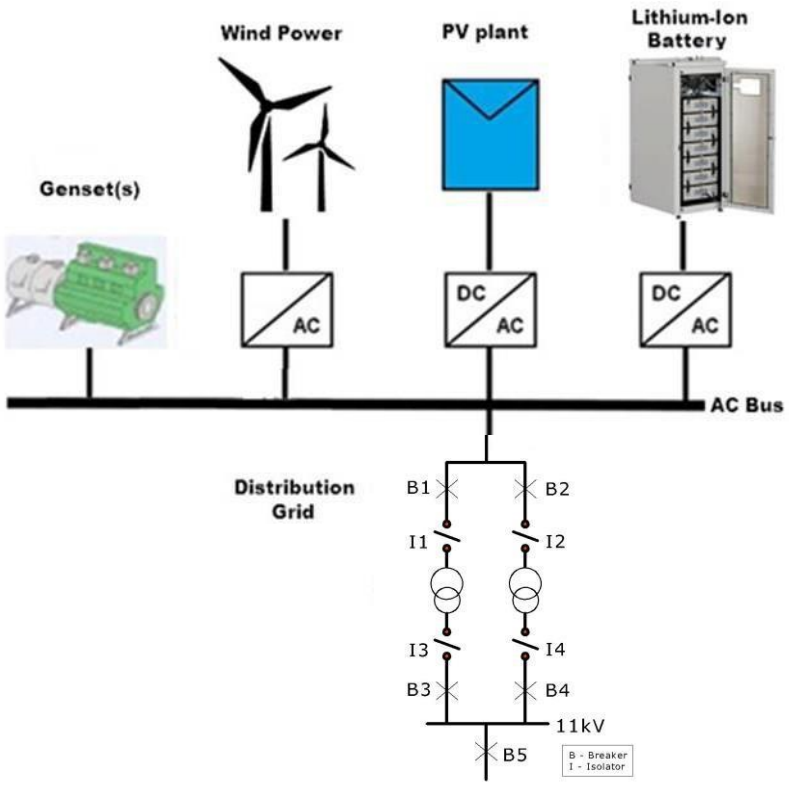


Figure 1. Conceptual design of the hybrid PV System with diesel generator and battery storage

The scope consists of system design, provision of all Plant required for construction work and associated incidental services (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 material storage, Civil design and construction, the manufacturing and supplying (including procurement, quality assurance, construction, installation, associated civil works, pre-commissioning and delivery) of the Plant and the installation, completion, commissioning, operation and maintenance of the Facilities in accordance with the plans, procedures, specifications, drawings, supplementary information, standards, codes and any other documents as specified.

2.0 Design

Optimal total generation capacities of PV, wind and Diesel sources have already been defined for each island and presented in section 1.0 above. The Contractor has to use the given capacities of energy sources to calculate sizes of the individual generating source components for each island. The sizes of individual components and layout design shall be done by the contractor in such a way that, all subsystems (Solar, Wind Generator and Diesel Generator) will work together to generate the optimum results. Basic design details are included here and more details are available in Chapters from Chapter 1 to 9.

Contractor has to select component and design a hybrid system for each island according to the following guidelines.

(i) The designed hybrid system shall have generation from all three sources namely PV, diesel, wind and a battery bank and Grid Management System to monitor and controlling all sources and selected loads.

(ii) The contractor can use the power demand curves and monthly energy generation measured in one year period and given in clause 3,4 and 5 for any designing and commissioning activity.

(iii) System shall be designed to supply annual energy requirement and daily peak load as mentioned in clause 3, 4 and 5 of this chapter.

(iv) The Contractor shall use a reliable source to find the average daily solar radiation intensity and the total annual sunshine hours of the selected sites if required for any designing or commissioning activity. It is recommended to use the National Renewable Energy Laboratories (NREL)'s data bases accessible to HOMER PRO software or equivalent. The contractor shall mention the source of the solar data source if solar data is used for any design or commissioning work.

(v) An annual average wind speed at 50 meters height is assumed as 7.5 m/s and the corresponding Weibull shape factor can be assumed as k=2 based on the wind atlas for Sri Lanka and Maldives published by the National Renewable Energy Laboratory in 2003. The map of Sri Lanka's wind average wind speeds published in this study is shown in the figure below.The Contractor shall use a reliable source to find average monthly and hourly wind velocity in the selected sites. It is recommended to use the NASA data available from the software HOMER pro or equivalent. The contractor shall mention the source of the input wind data if wind data is used in design or commissioning work.

(vi) There shall be a facility to connect diesel generators directly to the distribution network isolated from the hybrid system if necessary to provide total load at possible contingencies in hybrid system.

(vii) Battery capacity and charging and discharging rate shall be fast enough to respond sudden variations of renewable energy generations and load changes to maintain the system stability (Primary Control).

(viii) Batteries shall store excess energy generated by renewable sources, PV and wind, and subsequently discharge the accumulated energy during hours of low renewable generation to limit operation of diesel generators only a few hours a day when the demand is higher (Load Following Operation).

(ix) The Grid Management System needs to manage the turning on and off the genset available in the island and all the operations shall be seamless.

(x) Existing conditions and optimized hybrid solution shall be simulated with actual component data to analyze their cost over project life time of 25 years using the given power demand time series.

(xi) The system analysis shall be done with Hybrid Optimization Model for Electric Renewables (HOMER) software developed by National Renewable Energy Laboratory (NREL), USA or equivalent.

(xii) Individual equipment capacities shall be selected in such a way that even in the outage of any single unit, the system still shall be able to provide the continuous supply of the demand at any operating condition. On the other hand the system shall be designed to meet (N-1) reliability criteria.

(xiii) The outage of any single equipment or any single piece of auxiliary equipment shall not affect the operation of the remaining.

(xiv) All generation sources are integrated at three phase 400V bus and the power is stepped up to 11kV for distribution. System frequency is 50Hz.

(xv) The Contractor shall provide a design software and data files used in system analysis to the use of Project Manager throughout the project period without any additional cost.

(xvi) The Contractor shall review his design with counterpart engineers of the Project Management Unit and provide the final report.

(xvii) The transient stability of the final design shall be studied and presented in the design report. The necessary precautions such as energy reserve, load shedding scheme, load controlling techniques incorporated with inverters shall be evaluated by the Contractor to verify their capability to salvage the system in case of system is to face system faults and the action of nonlinear loads such as motor starting.

(xviii) The designed system shall have adequate fault level to operate the protection systems of outgoing feeders to save public lives especially from fallen conductors. The design report shall provide the calculated minimum and maximum fault levels at 400V and 11kV bus bars for different generation combinations. Contractor shall furnish in design report, the calculations of relay settings according to the calculated fault levels.

(xix) The designed system shall be operated in off grid mode. However, the required modification of the component of the system to operate it in grid connected mode in future, if required, shall be given in the design report.

(xx) The bidders shall use the actual component ratings, parameters etc. related to the product he offered in his bid for the system design and analysis.

(xxi) The Contractor shall provide three copies of the intermediate report for reviewing. Five coloured copies printed on high quality papers with a softcopy of the final report shall be provided.

(xxii) A Detailed Expansion Plan of the existing system for 10% growth shall be provided by the supplier.

(xxiii) This system shall have external algorithms for secondary control that factor load and renewable generation forecast to save fuel, optimizing the use of batteries.

The layout design shall be done by the bidder in such a way that, all subsystems (Solar, Wind Generator and Diesel Generator) will work together to generate energy at the minimum cost. Basic information required for the design is included here and specifications of the major items to be used are available in Chapters from Chapter 1 to 10.

3.0 Design, Supply and Installation of Plant in Nainativu

Nainativu is a small but notable island located 2 km off mainland of the Jaffna Peninsula, Sri Lanka. There were 1040 families (approximately 2750 people) living in the island in 2018.Electrification level is 88%.

The Contractor shall Design, Supply and Installation of a 400V, three phase, 50Hz, AC, hybrid energy system consisting of a 300kW and a 500kW Diesel generators, 700kWp of solar generation, 200kW of wind power generation and 1000kWh (550 kW) of battery energy storage system in Nainativu island.

The generated power at 400V is stepped up to 11kV and distribute throughout the island. The construction of a 0.4/11kV switching arrangement by providing transformers, protection system and switchgears is also included to the scope.

Location of the site is indicated in Figure 2. The coordinates of the site are 9° 39′ N, 79° 31′ E.

Figure 2. Location of site in Nainativu Island. Coordinates: 9° 39′ N, 79° 31′ E

Plan of the proposed site is attached as Annex-6A-01.

3.1 Existing site conditions

A medium voltage (11kV) network with line lengths of 3.52 km and 400V distribution network with line lengths of 16 km are presently available in the island. Two transformers of 400/11 kV (one 160 kVA and one 250 kVA) are used to step-up the diesel generators' output while two step-down transformers of 11kV/400V (one 160kVA and one 250 kVA) are used in distribution network.

3.2 Existing GenSets

Three diesel generators are currently in the island, two of them with a rated capacity of 250 kVA and the other being 500 kVA, which forces them to work at low loading levels during most of the day, thus having an overall bad efficiency. Specific fuel consumption data for this particular island has been calculated to be 0.385 liters/kWh from CEB fuel expenditures and energy sales.

3.3 Power Demand

Power demand was measured during the period 25.07.2018 (Wednesday) to 31.07.2018 in 30 minute intervals. The measured profile for each day and an average profile are shown in the images below.

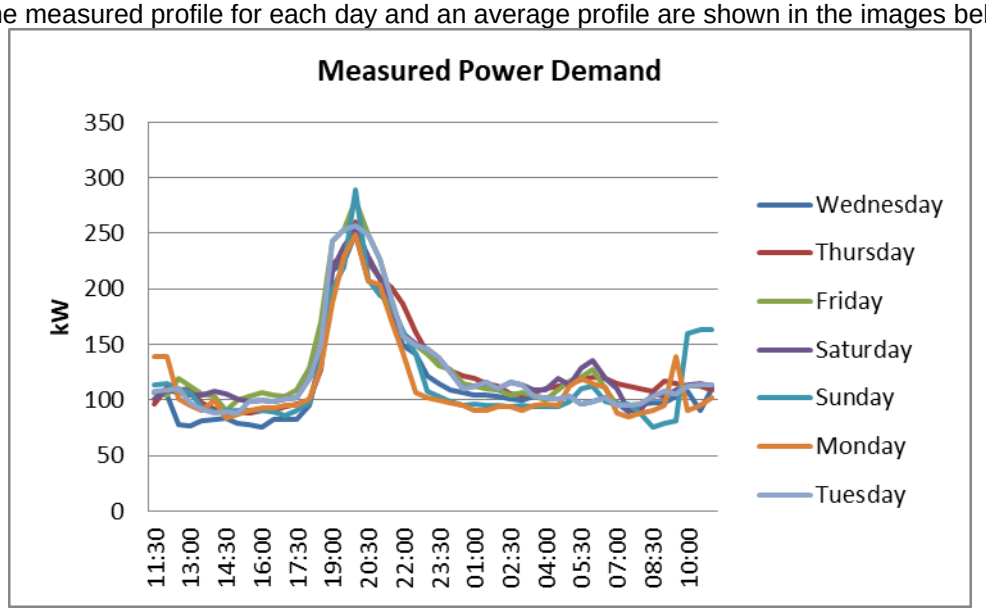


Figure 3. Measured daily demand profiles (kW) 25.07.2018 to 31.07.2018

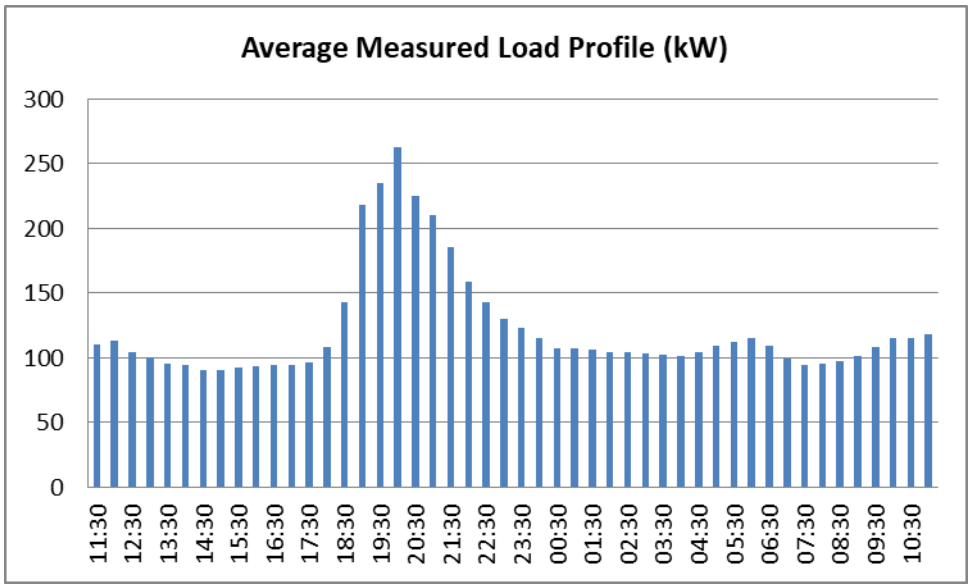


Figure 4. Average daily demand profile obtained from measurements

The rest of available information about demand is:

- Peak measured power demand over the period 25.07.2018 (Wednesday) to 31.07.2018 was 263 kW.

- Usage of electricity is mostly residential. The following consumer mix was provided by the electric utility company CEB:
    - 820 domestic consumers
    - 1 industrial consumers (drinking water supply system)
    - 73 general purpose

- 19 religious
- 04 government

- Average daily kWh generation is around 2778kWh in 2018.
- The hybrid system shall be designed and constructed to provide average daily energy generation of 4900kWh at 400V. Day time power factor of 0.92 ,night time power factor of 0.97 and the Load factor of 0.45 can be assumed at 400V for the system design.
- The Contractor shall design and construct a switch yard for stepping up of 400V generated electricity to 11kV for distribution purposes and design shall cover breakers, transformers, isolators, feeder protection relays, feeder current meters, structures, conductors and insulators required.
- Additionally water treatment plant is being constructed and scheduled to be in operation by 2020. Its power consumption capacity is 80kVA.

4.0 Design, Supply and Installation of Plant in Analativu

Analativu is a small island located 5km off mainland of the Jaffna Peninsula, Sri Lanka. The island is approximately 4 km long with an approximate surface of 6 km2. The population in 2018 is 2,324 inhabitants (540 families). There are 3 schools and a hospital in the island. The electrification level is 85%.

The Contractor shall Design, Supply and Installation of a 400V, three phase, 50Hz, AC, hybrid energy system consisting of a 150kW and a 300kW Diesel generators, 300kWp of solar generation, 80kW of wind power generation and 550kWh (275 kW) of battery energy storage system in Analativu island.

The generated power at 400V is stepped up to 11kV and distribute throughout the island. The construction of a 0.4/11kV switching arrangement by providing transformers, protection system and switchgears is also included to the scope.

Location of the site is indicated in Figure. 5. The coordinates of the site are 9° 39′ 19″ N, 79° 45′ 42″ E.

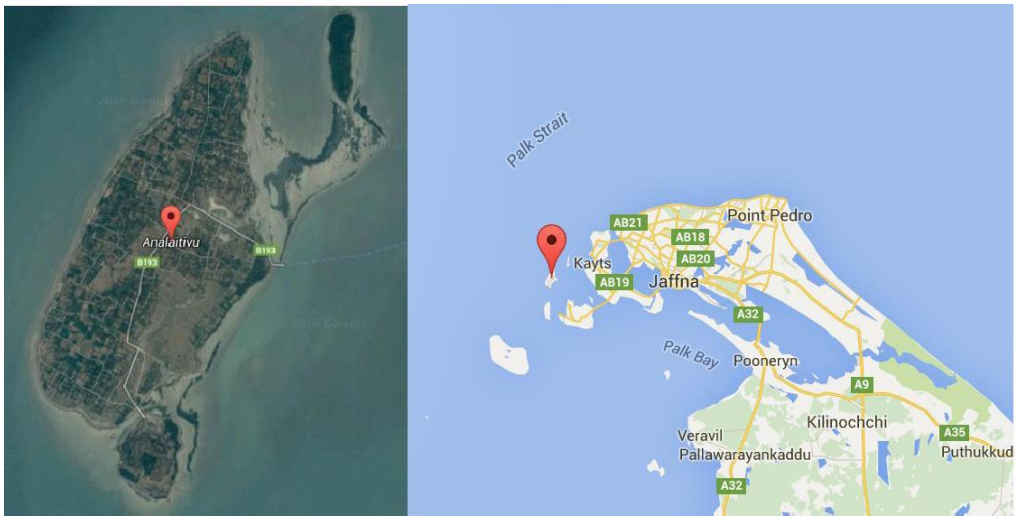


Figure 5. Location of site in Analativu island. Coordinates: 9° 39′ 19″ N, 79° 45′ 42″ E

Plan of the proposed site is attached as Annex-6A-02.

4.1 Existing Site Conditions

There is a 230V low voltage distribution network in the island through which the electricity generated by four diesel generators is fed to costumers. The generated power at 400V is stepped up to 11kV and distribute throughout the island. The length of the distribution network is approximately 13 km.

4.2 Existing GenSets

Four diesel generators are currently in the island. Their rated power capacities are 28 kVA, 100 kVA, 180 kVA and 250 kVA. Specific fuel consumption data is not available, but it is assumed to be high based on the experience in other islands in the Jaffna Peninsula.

4.3 Power Demand

Power demand was measured during the period 25.07.2018 (Wednesday) to 31.07.2018 in 30 minute intervals. The measured profile for each day and the average measured profile are shown in the images below.

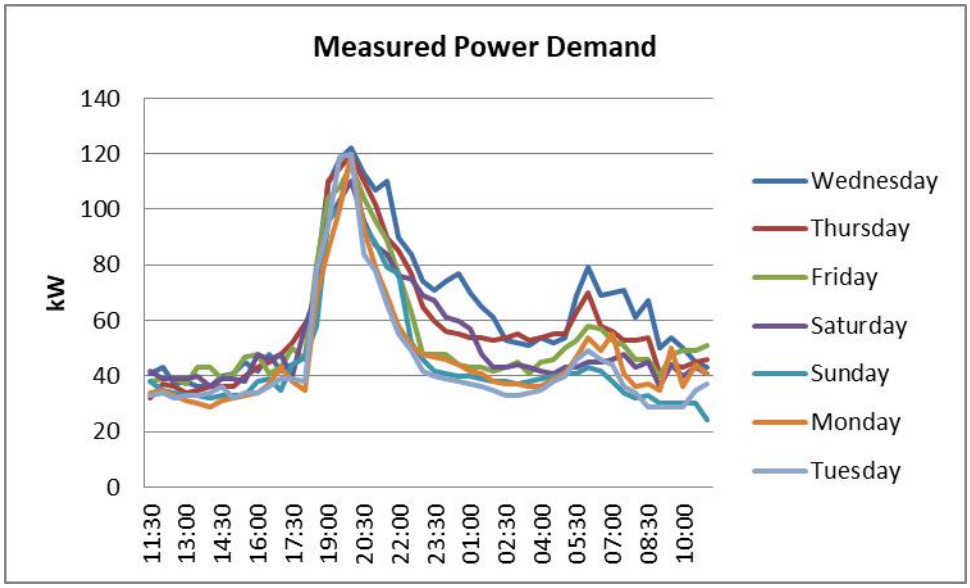


Figure 6. Measured daily demand profiles 25.07.2018 to 31.07.2018

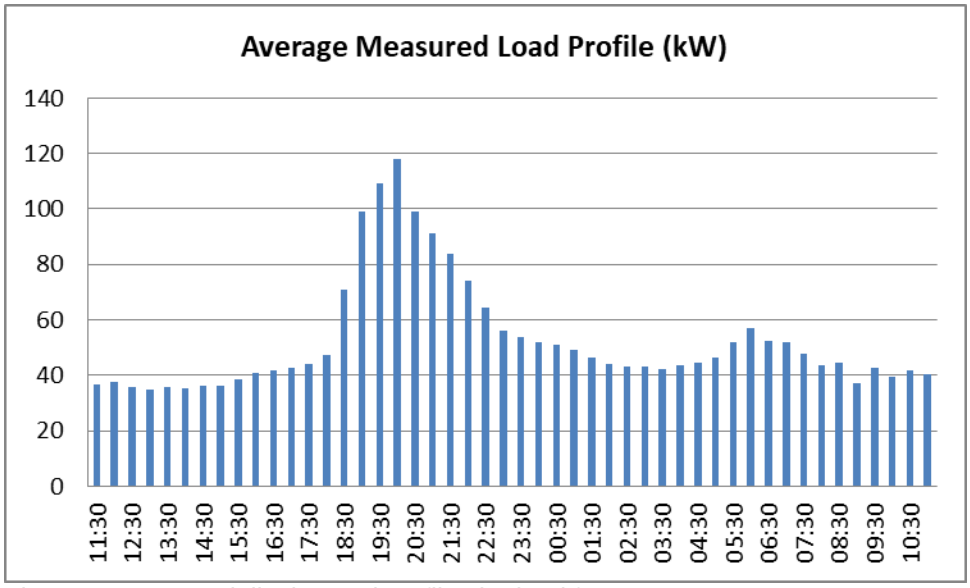


Figure 7. Average daily demand profile obtained from measurements

The rest of available information about demand is:
Peak measured power demand over the period 25.07.2018 to 31.07.2018 was 118 kW.

Usage of electricity is mostly residential. The following consumer mix was provided by the electric utility company CEB:
430 domestic consumers
01 industrial consumers
73 general purpose
19 religious
04 governments

- Average daily kWh generation is around 775kWh in 2017. The hybrid system shall be designed and constructed to provide average daily energy generation of 2115kWh. Day time power factor of 0.92 ,night time power factor of 0.97 and the Load factor of 0.45 can be assumed at 400V for the system design.
- The Contractor shall design and construct a switch yard for stepping up of 400V generated electricity to 11kV for distribution purposes and design shall cover breakers, transformers, isolators, feeder protection relays, feeder current meters, structures, conductors and insulators required.

5.0 Design, Supply and Installation of Plant in Delft

Delft is the biggest island in Sri Lanka, located 10 km off mainland of the Jaffna Peninsula, Sri Lanka. The island is approximately 11 km long with an approximate surface of 50 km2. The population in 2015 is 4,540 inhabitants (1430 families). There is a growing tourism in the island due to different attractions such as Dutch history, its temples and wild horses. The electrification level is 87%.

The Contractor shall Design, Supply and Installation of a 400V, three phase, 50Hz, AC, hybrid energy system consisting of a 300kW and a 500kW Diesel generators, 700kWp of solar generation, 250kW of wind power generation and 800kWh (650 kW) of battery energy storage system in Delft island.

The generated power at 400V is stepped up to 11kV and distribute throughout the island. The construction of a 0.4/11kV switching arrangement by providing transformers, protection system and switchgears is also included to the scope.

Location of the site is indicated in Figure 8. The coordinates of the site are 9° 31′ N, 79° 41′ E.

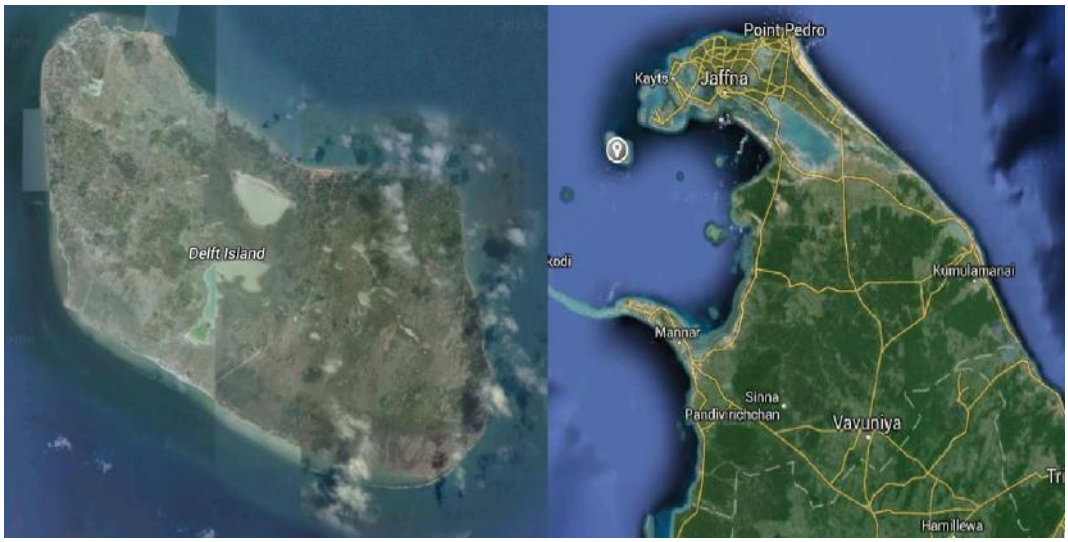


Figure 8. Location of site in Delft Island. Coordinates: 9° 31′ N, 79° 41′ E

Plan of the proposed site is attached as Annex-6A-03.

5.1 Existing Site Conditions

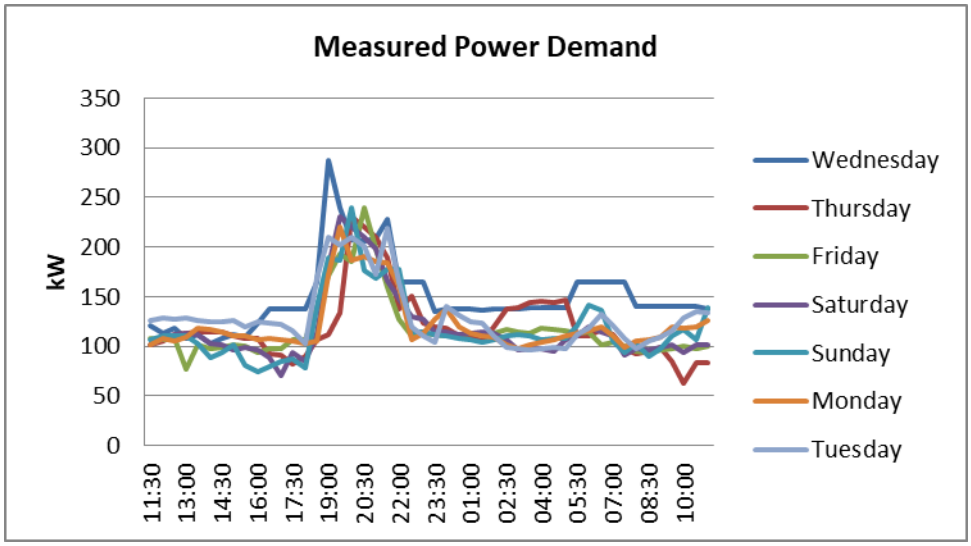
In Delft, the output of the diesel generators is stepped up using 400V/11kV transformers and transmitted through medium voltage lines with a total length of 7.5 km. The low voltage distribution lines are 15.6 km long in total.

5.2 Existing GenSets

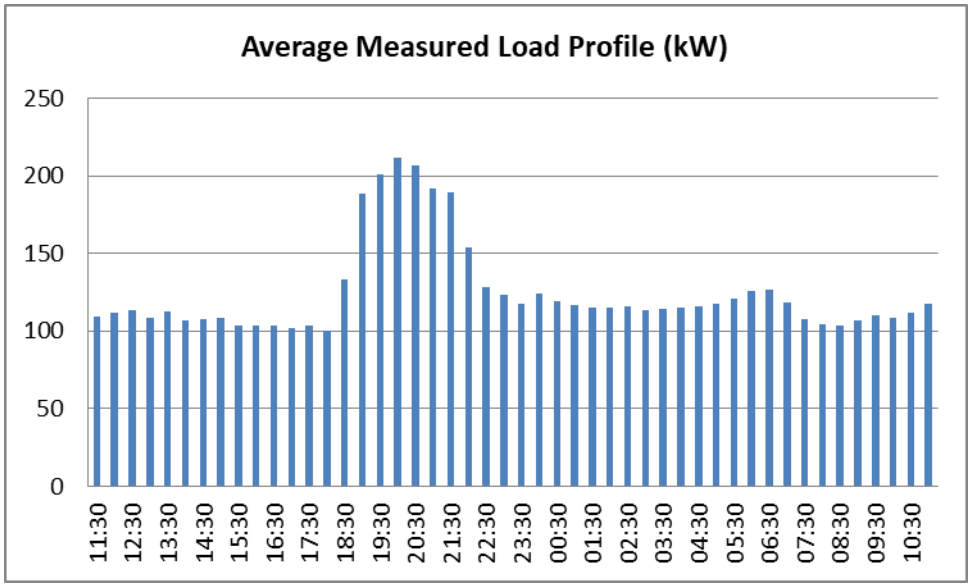
Three diesel generators are currently in the island, all of them with a rated capacity of 250 kVA, which forces them to work at low loading levels during most of the day, thus having an overall bad efficiency. Specific fuel consumption data for this particular island is not available, but it is assumed to be similar to other islands in the Jaffna Peninsula for which this information is known.

5.3 Power Demand

Power demand was measured during the period 25.07.2018 (Wednesday) to 31.07.2018 in 30 minute intervals. The measured profile for each day and an average profile are shown in the images below.



– ***Figure 9. Measured daily demand profiles*** 25.07.2018 to 31.07.2018



– ***Figure 10. Average daily demand profile obtained from measurements***

The rest of available information about demand is:

- Peak measured power demand over the period 25.07.2018 to 31.07.2018 was 211 kW.
- Usage of electricity is mostly residential. The following consumer mix was provided by the electric utility company CEB:
  - 1162 domestic consumers
  - 0 industrial consumers
  - 52 general purpose
  - 30 religious
  - 06 government
  - 01 Bulk

Additionally one 60A, three phase hotel consumer and three nos of 30A, three phase metal crushers are to be supplied by 2020.

- Average daily kWh generation is around 2780kWh in 2018.The hybrid system shall be designed and constructed to provide average daily energy generation of 6475 kWh. Day time power factor of 0.92 ,night time power factor of 0.97 and the Load factor of 0.5 at 400V can be assumed for the system design.
- The Contractor shall design and construct a switch yard for stepping up of 400V generated electricity to 11kV for distribution purposes and design shall cover breakers, transformers, isolators, feeder protection relays, feeder current meters, structures, conductors and insulators required.

6.0 Climate

The Bidder shall be deemed to have inspected the selected sites and its surroundings and information available in connection therewith before submitting his/her Bid. This includes but not limits to, the form and nature thereof, including the subsurface conditions, the hydrological and climatic conditions, the extent and nature of work, goods and materials necessary for the completion of the work, the means of access to the site and the accommodation required and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Bid.

The climate is that of a tropical region and the following meteorological information is set out for guidance only.

Given climatic data are for the 10 years period of 2006-2016 measured in Jaffna.

6.1 Air Temperature

Further, maximum and minimum temperature in Jaffna peninsula recorded by the Sri Lankan Metrological Department for past ten (10) years is shown in Table 1.

Table 1 – Mean Daily Maximum and Minimum Temperature in Jaffna for 2006-2016

Month	Mean Daily Max. Temp. / ^{0}C	Mean Daily Min. Temp. / ^{0}C
Jan.	29	22
Feb.	31	22
Mar.	33	23
Apr.	34	26
May	33	28
Jun.	33	28
Jul.	33	27
Aug.	32	27
Sep.	32	27
Oct.	31	25
Nov.	30	24
Dec.	29	23
Year Average	32.33	22.80

6.2 Relative Humidity

Table 2 – Average Daily Percentage Relative Humidity in Jaffna for 2013-2016 period

Month	Jaffna
Jan.	84.2
Feb.	84.1
Mar.	83.1
Apr.	81.5
May	78.1
Jun.	81.5
Jul.	82.1
Aug.	82.1
Sep.	80.1
Oct.	85.0
Nov.	85.7
Dec.	85.7
Year Average	68.67

6.3 Rainfall

Table 3 – Average Rainfall (mm) in Jaffna for 2006-2016

Month	Jaffna
Jan.	44
Feb.	26
Mar.	54
Apr.	79
May	83
Jun.	13
Jul.	6
Aug.	60
Sep.	64
Oct.	231
Nov.	420
Dec.	267
Year Average	44

6.4 Wind

Annual Average wind speed in Jaffna for each month of the year is shown in Table 4.

Table 4 – Average monthly wind speed (mm) in Jaffna for 2006-2016

Month	Monthly Average/ (km/h)
Jan	7.1
Feb	7.1
Mar	6.9
Apr	6.5
May	9.8
Jun	11.0
Jul	10.2
Aug	10.3
Sep	10.2
Oct	6.5
Nov	5.1
Dec	6.8

On-site wind speed measurements in islands are not available. An annual average wind speed at a 50 meters height of 7.5 m/s based on a Weibull shape factor k=2 has been considered based on the wind atlas for Sri Lanka and Maldives published by the National Renewable Energy Laboratory in 2003. The map of Sri Lanka's wind average wind speeds published in this study is shown in the Figure 11.

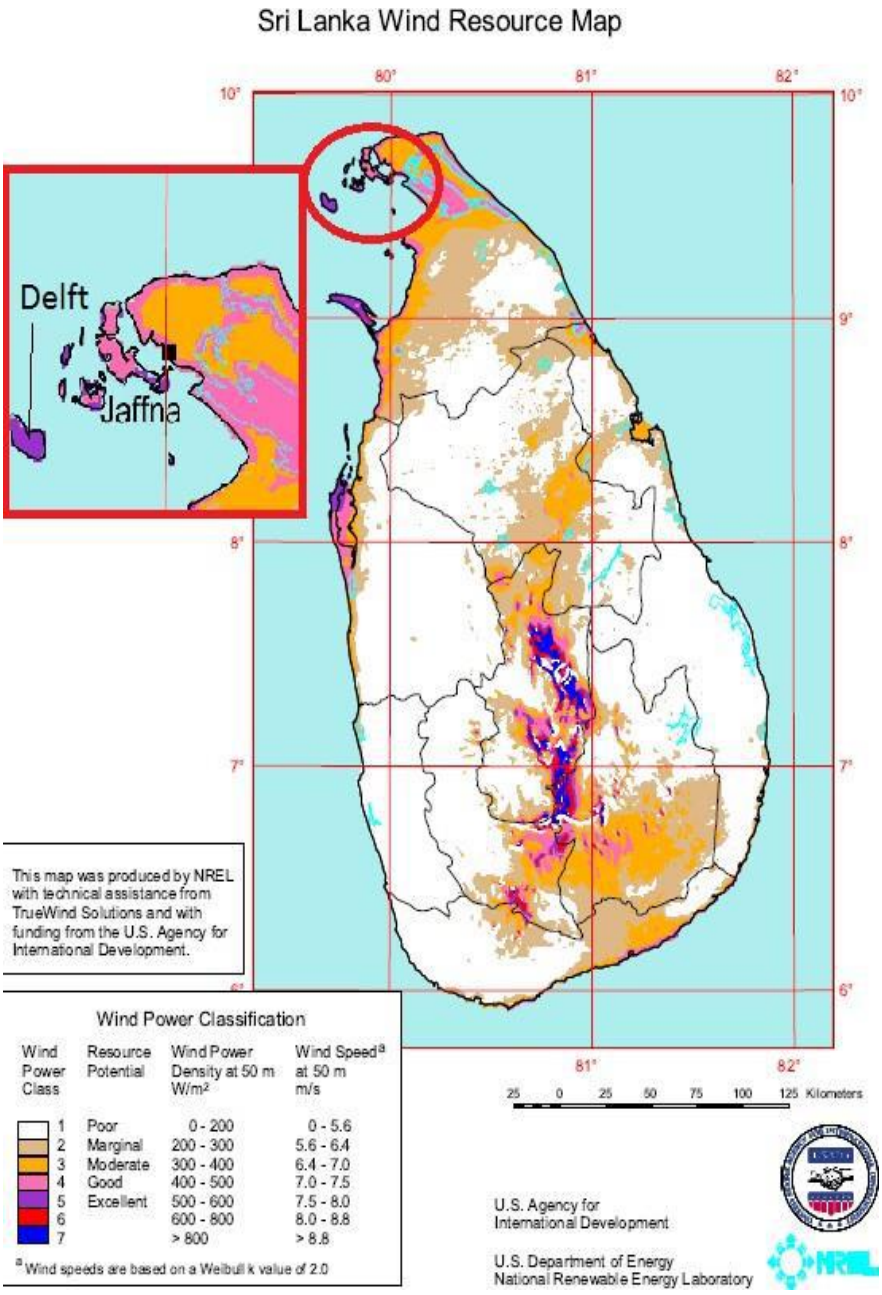


Figure 11. Wind resource map of Sri Lanka. Source: NREL. Wind Energy Resource Atlas of Sri Lanka and the Maldives.

6.5 Storms

The frequency of thunder-storms is high, the isokeraunic level being approximately 90 days per annum on average for the island.

7.0 Plant & Material Including Spare Part

Summary of Requirements: The scope is categorized below while details are included in Part B of Section- 6:

(a) Photovoltaic modules

(b) Supporting structures for PV modules

(c) Photovoltaic inverters

(d) PV array wiring junction box

(e) Other accessories of PV system

(f) Wind turbines

(g) Towers for wind turbines

(h) Converters for wind turbines

(i) Dump loads for wind generators

(j) Wind power inverters

(k) Other accessories for wind generator system

(l) Diesel generators

(m) Auto and manual Synchronize panel

(n) Other diesel generator elements

(o) Batteries

(p) Standalone DC/AC inverter(s)

(q) Control switch box and accessories

(r) Power plant controller (Battery Management System)

(s) Earthing

(t) Data acquisition and monitoring and controlling system

(u) Inter-connection cables

(v) Associated panel boards for DC & AC bus bars and volt, ampere and energy meters

(w) System installation, associated works and services

(x) Allied buildings for battery storage, diesel generator, charge controller, inverters and panel boards as well as for the living of O&M staff. The area of the building may adjusted depending on the layout of batteries in the battery room. The rooms for power electronics and living areas must be partitioned from battery room.

(y) Associated and incidental civil works (land and site development, pathways, fencing, waste water disposal, conducting contour survey and soil testing, foundations)

(z) Foundations

(aa) On-site training on operational and maintenance aspects of the system

There are two categories of spare parts; mandatory spare parts and recommended spare parts. The price quoted for the mandatory spare parts will be included in the bid evaluation while the recommended spare parts while the recommended spare parts are not included in the bid evaluation.

Refer Schedule No 1 and Schedule No 2 in Section 4 - Bidding Forms for Plant & Materials including Mandatory Spare Parts from outside the Employer's country and Plant & Materials including Mandatory Spare Parts from within the Employer's country.

Refer Schedule No 3 in Section 4 - Bidding Forms for Design services.

8.0 Installation, Other Services and training

8.1 Installations

Guidance for all the installation works are described in chapter 1 to 9 of Section 6-Part B: Specifications.

Refer Schedule No 4 in Section 4 - Bidding Forms for Installation and Other Services.

8.2 Other Services

8.2.1 Accommodation for Employer's Representative

Onsite office for Employer's Representative as per clause 1.7.1(a), Chapter 1 of Part B - Technical Specifications of Section 06 of the Bidding Document.

8.2.3 Transport for Employer's Representative

Transport for Employer's Representative should be provided as per clause 1.7.1(d) of Chapter 1 of Part B - Technical Specifications of Section 06 of the Bidding Document.
The following vehicles shall be provided to the Employer at the initiating the project Four wheel driven off road vehicles (double cabs). 02 Nos

(a) Electric three-wheel 03 Nos

8.2.4 Communication Facilities for Employers Representatives

Communication Facilities for Employer's Representative should be provided as per clause 1.7.1(g) of Chapter 1 of Part B - Technical Specifications of Section 06 of the Bidding Document.

The Contractor shall provide 05 Nos of GSM/Mobile phones as communication Facilities for Employer's Representatives during the contract period. This communication Facility shall belong to the active communication network in such areas.

8.2.5 Testing

Testing shall be carried out as per Chapter 7 of and Chapter 9 of Section 06, Part B - Technical Specifications; of the Bidding Document.

9.0 Training

The contractor shall make necessary arrangements to provide trainings as specified in clause 1.7.2 of Part B - Technical Specifications of Section 06 of the Bidding Document.

10.0 Adherence to the Environmental Mitigation Measures

Bidders are requested to comply with the requirements stated in the Chapter 1, clause 1.43 of Section 6 Part B -Technical Specifications.

Annex -6A-01

Plans of the Proposed Site - Nainativu

Annex -6A-02

Plans of the Proposed Site - Analativu

Annex -6A-03

Plans of the Proposed Site - Delft

Part B - Specifications

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Chapter 1 – General

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Chapter 1 – General

1.1 General Description of the Project

This project is for design, supply and installation of three 400V, AC, distributed renewable hybrid energy Plants at Analativu, Nainativu and Delft islands in Jaffna peninsula of Sri Lanka and interconnection facilities to 11kV network to reduce the electricity generation cost and thereby improving the living standards of inhabitants of these islands.

The geographical locations of these sites are shown on drawings attached as Annex-C1 in Part C of Section 06.

1.2 Extent of Contract

This specification includes the design, manufacture, supply, testing, galvanizing, painting (where specified), insurance, packing for export, shipment to a tropical climate, delivery to the site, unloading, soil investigation, clearing for and provision of access roads where necessary, complete erection, setting to work and defect liability for a period of 12 calendar months of the specified Plants. Necessary construction approvals from the relevant government authorities shall be arranged by the employer and designing, manufacturing, supplying, transporting, erection, testing and commissioning shall be carried out by the Contractor.

1.3 Spare Material

The spares set out quantities of spare materials which are required by the Employer, and which will be paid for at the rates entered in the Schedules. In the event that the Employer requires other spares not listed in the Price Schedules, these shall be supplied at the appropriate C.I.F. rates entered in the Schedules, and delivered to stores and handed over at Local Transport and Delivery Rates to be agreed with the Project Manager at the appropriate time. Where, in the case of a particular spare item no specific rate is given in the Schedules, such item shall be supplied by the Contractor at a rate agreed by the Project Manager based on comparable schedule rates.

If any spares shall be ordered after the date of the Completion certificate in question, the price may be subject to adjustment.

Any spare material shall be strictly interchangeable with the parts for which it is intended, packed or treated in such a manner as to be suitable for storage in the climate at the site for an indefinite period and each part is to be clearly marked for identification purposes, outside the package where applicable. Spare material shall be delivered and handed over to the stores nominated by the employer as follows.

Spare materials shall be delivered toplace in Jaffna area nominated by the IA. .

All packing remains the property of the Employer.

Spare material packing shall be protected as specified and treated in an approved manner to resist termite and fungus attack during long term storage and it should be transportable.

Spare material so provided shall be delivered into such stores as may be nominated by the Employer and delivery will not be deemed to be completed until packaged material has been checked by a representative of the Employer and a receipt obtained. A copy of the receipt must accompany the invoice when requesting payment. Prior to the handing over date for contract spares the Contractor shall be responsible for all security arrangements and the safe custody of the spare materials.

1.4 Clearance

The following are the minimum clearances between live conductor and other objects, which correspond to the condition of maximum sag of conductor and conductors hanging vertically or

deflected up at any angle up to 40 degrees from vertical. Telecommunication lines and Cradle Guards over railway are to be considered as power line at 33kV or less.

Table 1.4.1 – Minimum Line Clearances

Item	Description	Clearance (m)
1	Ground clearance (Normal)	6.1
2	Public roads (normal)	6.4
3	Public road ("High road")	6.4
4	Ground inaccessible to vehicles	5.2
5	Any other object on which a Person may stand or against Which a ladder may be placed.	3.0
6	Any other object to which access is not required, and on which a person cannot stand or against which a ladder cannot be placed.	2.0
7 7.1 7.2	Trees :- Standing trees Falling tees, to line in still air	 3.0 0.8
8 8.1	Crossings with other lines (at the worst case) between Conductors (above or below) where the voltage of the line Crossed is: 33 kV or less	3.0
9 9.1	From any point on a support where a person may stand to any conductor of the line crossed at: 33 kV or less	4.0
10	To support of another line.	7.5

1.5 Access to the Sites

The drawings (Annex C1) show the sites selected for Plants to be constructed under this contract.

The main port of entry into Sri Lanka is Colombo/Trincomalee

The Contractor shall make his own arrangements for transporting materials to the project sites by whichever method he chooses including arrangements for off-loading, storage areas and distribution

points. Any limitation on loads due to local conditions, such as restrictions on bridges, availability of railway wagons, etc., shall be taken into account by the Contractor.

Special attention shall be given for assessment of available transportation Facilities for sea transportation and land transportation inside the islands.

Survey Department Maps, scale 1: 50,000 or 1 inch to 1 mile (1:63360) giving road and rail communications, ground contours and local features in the area are available.

1.6 Safety of Personal

The maximum safety, consistent with good erection practice in the case of work above ground, must be afforded to personnel directly engaged on this Contract, or who in the normal course of their occupation find it necessary to utilize temporary works erected by the Contractor or frequent the working area. Reasonable measures shall be taken to afford adequate protection against material falling from a higher level onto personnel below.

Special precautions shall be taken during transportation of staff by sea to avoid possible accidents.

Particular care shall be taken while working near to energized power lines.

The operation of or connections to any items of equipment once made live shall be subject to a "Permit to Work" system in a form agreed between the Project Manager and the Employer in accordance with the Employer's standard regulations for such work.

The operation of or connections to any items of transmission Line in live (full hot line) condition shall be subject to a "Permit to Work" system in a form agreed between the Employer's Representative and the Employer in accordance with the Employer's standard regulations for such work.

1.7 Other Services and Training

1.7.1 Other Services

(a) Accommodation

The Contractor shall make his own arrangements with regard to accommodation for his expatriate staff and locally recruited labour during the construction of the Plant.

All dwellings and buildings existing or erected for the purpose by the Contractor shall comply with local regulations in regard to construction, water supply and sanitation and other requirements. Temporary construction camps shall be provided with proper sanitation and other necessary Facilities. All accommodation shall be removed by the Contractor when no longer required and before the granting of the Final Certificate. After the removal of accommodation the ground shall be left in a clean and tidy condition.

The Contractor shall provide and maintain office accommodation for Employer's supervision staff at the locations as requested in the Scope of Works.

Contractor shall provide staff for cleaning and general duties in all living accommodations.

(b) Storage Facilities

The Contractor shall make his own arrangements for storage areas and camp sites.

The Contractor shall make necessary arrangements against corrosion and mechanical damage during storage and erection at site to the satisfaction of the Project Manager. Damaged or defective material shall not be used for construction purposes.

(c) Electricity and Water Supply, Lifting Facilities, Medical Arrangements

The Employer will not be able to assist the Contractor in any specific arrangement for provision of the above items. The Contractor must therefore make his own arrangements in this respect.

(d) Transport for Project Manager personnel

The Contractor shall provide, maintain, and keep available at all times, the transport for the exclusive use of the Employer's officers engaged in the project. In the event of unavoidability due to repairs or overhaul, the contractor shall provide equivalent substitute.

Contractor shall provide two (2) numbers of motor vehicles and three (3) of electric three wheels for transporting Employer's staff.

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The specification for the motor vehicles shall be as following.

Off road 4WD Double Cab vehicles with minimum engine capacity of 2800 cc or less (not less than 2400cc) diesel engine, four door, 4 passenger capacity with air conditioning, CD/radio and all other standard fittings and safety facilities such as seat belts, head rests, SRS air bags for front passenger/driver, height adjustable seat for driver, power mirrors, ABS brakes with EBD, and Auto transmission.

The specification for the Electric three wheel shall be as following.

All vehicles and the three wheel shall be brand new when supplied and remain a property of the contractor throughout the duration of the contract.

One month after the Completion Certificate is issued the vehicles and the boat shall be handed over to the employer. They shall be in sound technical condition with new tires, including spares and complete set of tools. All damages shall be repaired and full technical service performed all to the satisfaction of the Project Manager.

The contract rates for transport of the Project Manager's personnel shall include for each vehicle the fixed cost of the vehicle; comprehensive all inclusive, insurance, registration, license plates, fuel oils, lubricants, repairs, maintenance and the provision of one full time competent driver for vehicles and a skipper for the boat and all other costs and charges not specifically mentioned but which may be incurred during running and keeping of the vehicles throughout the contract.

The contractor shall provide the vehicles and as above; not later than two months from the contract commencement date.

The vehicles and the boat shall be made available full use during the period of contract working hours are 7.00 to 18.00 hours from Monday to Sundays. The vehicle should be available on after 18.00 hour if necessary.

(e) Staff Transport

The Contractor shall provide, at his own expense, all necessary transport for his own men and materials.

(f) General

Without prejudice to the generality of the several Clauses of the Contract and except for the Facilities referred to in this clause, particular attention is drawn to the obligation of the Contractor to make his own arrangements at his own expense for supply and furnishing of offices, workshops, stores and store compounds and the watching and guarding of such.

(g) Communication Facilities

The Contractor shall provide Mobile communication facilities including connection and devices with navigation facilities, monthly charges for voice and data with his own expenses for the for the Project Manager's Supervision Staff (04 numbers of persons) for communication during the contract period via the active communication network in the project related area.

1.7.2 Training

For planning and design of Plants are described in the following training modules.

(a) Module 01 (Local)- Planning, design and implementation of Plants

The contractor shall provide comprehensive training on project implementation prior to and covering each stages of the project such as design, erection, commissioning & testing including project management and documentation. Detailed training proposal including areas/stages with time duration required to cover each section shall be submitted with the bid.

Number of Participants: Five (5) Engineers

Estimated duration of the training: two (2) weeks

Part A: To gain a solid understanding of different aspects in hybrid Plant project implementation

a) Feasibility studies of renewable energy sources (PV and Wind)

b) Planning of hybrid Plant with commercially available software tools

c) Equipment specifications and their standards

d) Economic evaluation of hybrid distribution project proposals

e) Relevant international standards for Hybrid energy Plants

f) Implementation techniques , issues related with hybrid energy projects

g) Testing and commissioning of hybrid energy Plants

h) Operational and maintenance activities of hybrid energy Plants

i) Application of advanced control systems and SCADA system for enhanced performance

Part B: Screw Foundations

a) Feasibility study on different type of foundations

b) Design of anchor foundations with commercially available software.

c) Relevant international standards for helical anchor design

d) Economic analysis of helical anchor foundations

e) Erection Methodology

(b) Module 02 (Local): Operation and Maintenance of the Plants

The contractor shall provide comprehensive training on operation of each and every equipment and the complete system. This training shall extend to maintenance of each and every equipment and the Plant. Detailed training proposal including areas/stages with time duration required to cover each section shall be submitted with the bid.

Number of Participants: Four (4) Engineers and Four (4) Electrical Superintendents

Estimated duration of the training: Two (2) weeks

a) Main features of installed equipment (wind Generator, solar panels, diesel generator, battery bank, inverters, battery management system, controller unit, etc.)

b) Complete description about the operation of the Plant with actual data (operational limits of all the equipment in the Plant, control algorithms, allocations for future expansions, etc.)

c) Maintenance of all the equipment and Plant (maintenance check lists, mandatory spares, maintenance schedules, etc.)

The full cost of the training including course fee, local accommodation and food, , transport, training material, site visits etc. for the above trainings shall be borne by the contractor

The relevant software packages used for the design shall be provided with license.

1.8 Design, supply and installation

Each of the several parts of the Plant shall be of such design, supply and installation as to give long and continuous service with high economy and low maintenance costs.

All material used under this Contract shall be new and of the best quality and workmanship and shall be of the highest class throughout with the designs and dimensions of all parts such that the stresses to which they are subjected shall not render them liable to distortion or damage under the most severe conditions encountered in service. Welding, filling, plugging or any repair to defective parts shall not be permitted without the sanction in writing of the Project Manager.

All equipment shall operate without undue vibration and with the least possible amount of noise and shall not cause a nuisance.

The detailed design shall be such as to facilitate inspection, cleaning and repairs and simplicity of operation. All apparatus shall be designed to ensure satisfactory operation under the atmospheric conditions prevailing in the area where the Plants are to be built, irrespective of season, and under such variations of load and voltage as may occur under the working conditions of the system. The design of all equipment, supports, conductors, insulators and fittings shall be such as to minimize the risk of damage due to deterioration. The design shall incorporate any reasonable precaution and

provision for the safety of those concerned in the maintenance of the Contract Works and all associated works supplied and executed under other contracts.

All corresponding parts shall be made to gauge, shall be interchangeable wherever possible throughout the Contract Works, and are to be such as will facilitate the fitting of replacement parts.

1.9 Compliance with Standards

Unless another standard is specifically mentioned in this Specification, all materials used and provided under the Contract, must, where such standard exists, be in accordance with the Standards of the International Electrotechnical Commission or the British Standards Institution last published standard prior to the date of closing of Bids or in accordance with such other authoritative standard appropriate to the country of manufacture as in the opinion of the Project Manager ensures to be equivalent or higher quality.

At the bidding stage, the standards to which the equipment is manufactured and to which materials conform must be clearly stated if it is different from the standards of the IEC or BS.

If the Contractor offers materials or equipment which conform to standards other than those published by the International Electrotechnical Commission or the British Standards Institution, full details of the differences between the proposed standard and equivalent British Standard, in so far as they affect the design or performance of the equipment, are to be supplied by the Contractor to the Project Manager for approval. In this case a copy of the standards in the English Language shall be provided to the Project Manager.

1.10 Statutory Regulations

The Works and all plant, equipment and materials forming part of this Contract are to comply in all respects with any relevant local Statutory Regulations, By-laws and Orders currently in force.

1.11 Language

The English language is to be used in all documents contained in the Contract and in all correspondence between the Contractor and the Project Manager. Whenever anything is required under the terms of the Contract to be written, marked, printed or engraved, the English language is to be used except where otherwise provided in this Specification.

1.12 Correspondence

All correspondence on matters arising out of the Contract is to be addressed by the Contractor to the Project Manager.

1.13 Unit of Measurement

In all correspondence, in all technical Schedules and on all drawings units of measurement International System of Units (SI) are to be employed.

Angular measurement shall be in degrees, with 90 degrees comprising one right angle.

1.14 Erection and Checking the Site

All work at site shall be carried out in such a manner as not to obstruct operations of any other Contractor engaged on different activity or the operation of any existing generators and power lines.

The carrying out of all 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 afforded by the Contractor for the Project Manager to check the Works. The supervisors shall have a good command of the English Language and any instruction given to them by the Project Manager shall be interpreted as having been given to the Contractor. The supervisors shall be well qualified by long training and experience in the installation and operation of equipment of the charter covered by the specification. They shall supervise and assist in installing, testing and placing in operation of the

system complete with ancillary apparatus. For all purposes the English language shall be used. The qualifications and experience of the Contractors proposed supervisory staff shall be communicated to the Project Manager for approval.

The Contractor shall obtain the details of the parts which the Project Manager wishes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if requested by the Project Manager, is to open up for inspection before installing any equipment which has been delivered to the Site partly assembled.

The Contractor shall keep the Site, on which he erects or stores plant, reasonably clean, removing all waste material resulting from the Works as it accumulates and as reasonably directed. On completion of the Works the Site shall be left clean and tidy to the satisfaction of the Project Manager. Any damage done to buildings, structures and plant or property belonging to the Employer and affected third parties if any; shall be made good at the Contractor's expense.

The Contractor shall be responsible for satisfying himself as to the correctness of the electrical and mechanical connection to all plant supplied under the Contract before such plant is brought into commission.

1.15 Transport to Site

The Contractor shall bear all expenses in connection with the importation and transportation to the Site of all plant, material and things needed for the purpose of the Contract including warehouse rent, handling and other charges.

The Contractor shall observe any regulations which limit loads on the roads, bridges and jetties over which material may be conveyed.

The handling and storage of any plant at the Site are to be at the risk of the Contractor and without responsibility to the Employer.

The Contractor shall arrange for the protection, to the satisfaction of the Project Manager, of all material against corrosion and mechanical damage during transportation especially at sea transportation, storage and erection at the Site.

1.16 Defects Liability Period

Please refer to the clause 27 of GCC.

1.17 Contractor's Employees

The Contractor shall fulfill all his obligations in respect of accommodation, food and medical Facilities for all personnel in his employ, in accordance with the responsibilities imposed on him by Clause 1.7.1 or as necessary to ensure satisfactory execution of the Contract. He is also to comply with the requirements of all local Statutory Employment Regulations and safety of the personnel.

The Contractor shall be responsible for the behavior on Site of all personnel employed by him.

1.18 Contractor's Responsibility

Please refer to the GCC 9.

1.19 Details of Offer and Variations from Specification

The Bid is to be accompanied by any necessary additional detailed specification of the various items of plant and equipment, which are offered and the Schedules in the Specification are to be completed.

Notwithstanding any description, drawings or illustrations which may be submitted with the Bid, will be deemed to be in accordance with the Specification and the standard specifications and codes referred to therein.

No departures from the Specification, excepting those shown in the tabulated statement and approved by the Employer, are to be made without the written approval of the Project Manager.

1.20 Working Drawings

Working drawings of all the materials to be used shall be submitted in 4 (four) copies to the Project Manager for approval before the work is put in hand, and at an early stage of the contract. The following essential documents, drawings shall be submitted for approval;

(a) Layout drawing of the power plant building.

(b) Schematic drawing of the Plant

(c) Design calculations and foundation details of the power plant building

(d) Design calculation and foundation details of the PV mounting pergola if any

(e) Design calculation erection drawings of the wind generator mounting structures and wind post foundations

(f) Design calculations for selection of air circulation system and air condition system for inverter rooms and battery banks respectively

(g) Design calculation and foundation details of the Diesel generator mounting pad

(h) Layout drawing for mounting of diesel generators indicating inlet air supply, exhaust system, fuel supply tank etc. with due consideration of sound level reduction inside the generator room and avoiding de-rating due to lack of proper ventilation.

(i) Design calculation and dimensional drawings of cable trenches, wire conduits etc.

(j) Design calculation and layout drawing of electricity and water supply system of power plant building

(k) Design calculations and layout drawings of PV array mounting structures

(l) Detailed drawings, installation instructions, operation and maintenance manuals, calculations for selection of conductors, fuses, circuit breakers, residual current devices ,surge protection devices of inverters, PV arrays, wind generators, dummy loads, diesel generators, battery banks, rectifiers etc.

(m) List of recommended operational and protection settings

(n) Information on system earthing arrangement and equipment body earthing arrangement with the calculation for earth conductor sizing

(o) Recommended operational and maintenance manuals

(p) Information about the suggested remote monitoring and operation system with due consideration of the communication technology employed.

(q) Equipment testing and commissioning schedules

(r) Details of metering system to be installed for recording energy generated by PV, wind , diesel and battery power with generating voltage, current, frequency of the individual sub system of the Plant.

(s) Design of 400V panel board including MCCB, fuses, surge protection devices and metering for interconnection of Plant with the existing 400V network

(t) Equipment identification labeling System.

(u) Safety labeling System.

After approval of drawings and documents by the Project Manager, the Contractor shall supply further four numbers of revised copies on medium or airmail paper as required. Further copies of particular drawings shall be provided if required. All Drawing shall accompany with a soft copy. All approved copies of drawings shall be made available and properly organized at the site office for the reference of employee representative.

Except as otherwise specifically approved, all drawings shall be of size not greater than A0 (namely 841 x 1189 mm) nor smaller than A4 (namely 210 x 297 mm).

If the contractor requires early approval of any drawing to avoid delay in the delivery of the Contract Works, he shall advise the Project Manager to such effect when submitting the drawings.

It is to be understood, however, that approval of the drawings shall not exonerate the Contractor from any responsibility in connection with the work.

All drawings submitted by the Contractor or by a sub-Contractor shall have the following particulars in the lower right-hand corner in addition to the Contractor's name, date, scale, number and title of the drawing, contract number and plant description.

Revision details are to be clearly and comprehensively recorded. Reference to the revision shall be made by a suffix to the drawing number.

All prints shall be folded to A4 size and the title, drawing number and revision suffix shall remain visible.

1.21 Program of Work

Within one month of acceptance of the Bid, the Contractor shall forward to the Project Manager four copies of Gantt charts in MS Project format detailing the plant manufacture, delivery and erection program for the Plants for approval. Copies of the approved charts as required by the Project Manager shall be provided by the Contractor with a soft copy.

The charts are to indicate realistically all the various phases of work for every item from the commencement of the work to its final completion, e.g. design, ordering of materials, manufacture, testing, delivery, erection and commissioning.

If at any time during the execution of the Contract it is found necessary to modify the approved charts, the Contractor shall inform the Project Manager and submit modified charts for approval. Such approval shall not be deemed to be consent to any amendment of the completion dates stated in the Schedule.

The Contractor shall provide for the Project Manager on site, weekly, a summary of erection work he proposes to carry out during the following week including exact activity, name of gang's leader, number of gangs involved, time of start and completion.

The Contractor shall arrange for shipment of materials in adequate time to suit the site erection program. He shall not, however, ship materials unnecessarily early in the Contract in order to take advantage of supplier's favorable prices thus involving the Employer in unnecessarily early payment.

1.22 Progress Report and Meetings

At monthly intervals after approval of the program charts referred to in Clause 1.21, the Contractor shall submit to the Project Manager detailed progress reports (in triplicate) in an approved form, indicating, the stage reached in the design, ordering of material, manufacture, delivery, transport and erection of all components of plant in comparison with that planned. These reports shall be forwarded promptly so that on receipt by the Project Manager the information contained therein is not more than seven days out of date. Copies shall also be forwarded to the Employer's Representative on Site.

During the progress of the work the Contractor shall provide a reasonable number of full plate size colour photographs of an approved type at the direction of the Project Manager. These photographs shall supplement the Progress Reports and Records where necessary, and show any unusual form of construction or foundation work. Up to three prints of photographs so ordered shall be handed over to the Project Manager, without delay.

If during execution of the Contract the Project Manager considers the progress position of any section of the work to be unsatisfactory, he shall be at liberty to call such meetings, as he deems to be necessary. If required by the Project Manager, Contractor's Project Manager with necessary officials shall attend such meetings.

Access to the Contractor's and sub-Contractor/s works shall be granted to the Project Manager at all reasonable times for the purpose of ascertaining progress.

1.23 Operating and Maintenance Instructions

Before commencement of commissioning the Contractor shall submit to the Project Manager for approval fully detailed operating and maintenance instructions together with recommended protection and operational equipment settings.

The instructions shall be as simple and clear as possible, fully illustrated with drawings and diagrams as necessary and detailed with part numbers for ordering of replacements. Two copies shall be supplied for the use of the Project Manager during erection work.

A further six copies shall be reproduced as a book or books of approximately A4 size and bound into strong black durable imitation leather covers inscribed upon the front generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, Drawings, etc., shall be replaced by "Operating and Maintenance Instructions".

The finished books shall be handed over to the Employer not later than one month before the Completion certificate is issued for the last hybrid system on this Contract.

1.24 Packing

The whole of the plant shall be packed where necessary in non-returnable cases or on non-returnable drums or otherwise prepared for overseas shipment to a tropical country in a manner suitable to withstand rough handling without sustaining damage.

Equipment shall be packed in a water resistant cover to protect them during sea transportation and subsequent storing at yards near the sea.

The dimensions and weight of the individual packages shall be selected to comply with the transport limitations of the intendant sea transportation vessel.

Packing cases where used shall be strongly constructed and in no case is timber less than 25mm in thickness to be used. The contents of packing cases shall be securely bolted or fastened in position with struts or cross battens. Cross battens supporting weight in any direction shall not rely for their support on nails or screws driven length wise into the grain of the wood, but shall be supported by cleats secured from the inside.

Bolts and nuts shall be crated for shipment.

Crating together of components of dissimilar metals is unacceptable.

Particular attention shall be given to strutting before packing cases are fastened down. Cases shall be up-ended after packing to prove that there is no movement of the contents.

Timber wedges or chocks shall be firmly fastened in place to prevent their displacement when the timber shrinks.

If light parts are fastened to the sides of a case, hoop iron straps secured by screws shall be used for the purpose. Nails driven in and bent over shall not be permitted.

Where bolts are used, large washers shall be fitted under the head and nut to distribute the pressure and the timber shall be strengthened by means of a pad.

Drums for conductor and earthwire shall be stoutly constructed of good quality timber and clearly marked with the length and type of conductor in a manner not easily removable. Drums shall be securely battened around the perimeter and shall be lined with approved material to give maximum protection to the conductor. Drums shall be suitable for rolling on the flanges without causing damage to the conductor or earthwire and the direction of rolling shall be clearly shown.

All drums and battens shall be protected from deterioration on site by termite or fungus attack by an approved impregnation treatment at the works before dispatch.

The first layer of conductor shall be secured to the hub in a manner avoiding damage to subsequent layers and shall be covered with approved waterproof lining.

The Contractors attention is drawn to the provisions of Clause 1.30 wherein the Contractor shall be required to protect all steel work before shipment to prevent damage to galvanized surfaces by white rust.

All stencil marks on the outside of casings shall be either of a waterproof material or protected by shellac or varnish to prevent obliteration in transit.

The use of wood wool as a packing material shall be avoided at all times.

Waterproof paper and felt linings shall overlap at seams at least 13mm and the seams secured together in an approved manner, but the enclosure shall be provided with screened openings to obtain ventilation.

Each crate or package shall contain a packing list in a waterproof envelope and copies in triplicate shall be forwarded to the Project Manager prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list.

All cases, packages, etc. shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.

The Project Manager may require to inspect and approve the packing before the items are dispatched but the Contractor is to be entirely responsible for ensuring that the packing is suitable for transit and such inspection shall not exonerate the contractor from any loss or damage due to faulty packing.

1.25 Erection instructions

Every equipment shall carry erection and operational instruction booklet describing the installation procedure, tools to be used in installation and steps to be followed in programming of operational and protections settings.

1.26 Grid Interconnection Points

This specification includes the provision for erection of interconnecting Facilities of the Plant with the existing 11kV power lines at a maximum distance of to be inspect and decide during the site visit. Hybrid system output generated at 400V shall be steeped up to 11kV and connect to 11kV network in all three islands.

Always two nos of step up 0.4/11kV transformers shall be supplied and installed by the contractor at the grid interconnection point. The transformer specification is given in Chapter 10 in Section 6- Employer's Requirements.

The contractor shall provide a panel board including isolators, MCCBs and LT surge protection devices, metering equipment for two nos of three phase, 400V, and outgoing feeders from the hybrid system. The Contractor shall provide connectors, conductors, jumper conductors and other material required for fixing each of the outgoing feeders of the hybrid system with each transformer.

Necessary 0.4/11kV step up transformers, mounting structures and protection equipment such as 11kV surge arrestors, 11kV transformer isolating switches and.

A 11kV circuit breaker with overcurrent and earth fault protection should be installed at the beginning of the 11kV feeder to protect the distribution network. A feeder protection device shall be incorporated to detect and immediately disconnect the fallen conductor of a distribution feeder to save public lives.

The sketch of the interconnection is shown below.

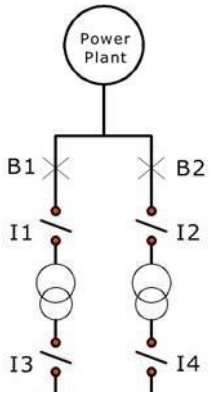

Figure 1: Grid interconnection

1.27 Bolts, Nuts and Washers

Members of steel lattice structures including wind masts, pergola shall be secured by means of bolts and nuts with approved spring washers. All bolts and nuts shall conform to ISO 898-1 and shall preferable have screwed threads of I.S.O form. Nuts and heads of all bolts shall be of the hexagonal type. Nuts (except locks nuts) shall be full bearing on one face.

Bolts for all structural connections shall be for both mild steel and high tensile steel.

All bolts, and screwed rods shall be galvanized including the threaded portions. All nuts shall be galvanized with the exception of the threads which shall be oiled. The nuts of all bolts attaching insulator set droppers, U bolts and earth conductor clamps to the towers shall be locked in an

approved manner. The screwed thread of any bolts or studs shall not form part of a shearing plane between members. When in position, all bolts or screwed rods shall project through the corresponding nuts for at least a full turn but such projection shall not exceed 10 mm.

All washers shall be included under this contract, including locking devices and anti-vibration arrangements, which shall be subject to the approval of the Project Manager. Taper washers shall be fitted where necessary.

Nuts shall be finger tight on the bolt and will be rejected if they are, in the opinion of the Project Manager, considered to have an excessively loose or tight fit. Bolts with threads re-died after galvanizing will be rejected. Nuts and bolts of the same size shall be interchangeable and supplied from one manufacturer.

The Contractor shall request his Supplier to select two samples of each type of bolt, nut and washer to be used in the Contract and send these two samples to the Project Manager for approval within one month of the date of issuing the sub-order. The Project Manager will then reject bolt consignments, which fall in any respect below the standard of samples submitted and approved. The importance of supplying good quality well finished nuts and bolts cannot be over emphasized.

1.28 Castings

All castings shall be as free from blowholes, flaws and cracks as is practicable. No welding, filling or plugging of defective parts shall be done without the sanction of the Project Manager and then only with his approval in writing. All cast-iron shall be of close-grained quality approved by the Project Manager.

1.29 Welding

In all cases where fabrication welds are liable to be highly stressed, such as may be the case in parts subject to reversal of stresses in operation, the Contractor shall supply the Project Manager with a general arrangement drawing of the fabrication and, at a later date, but before fabrication commences, a detailed drawing of all proposed weld preparations on the fabrication. Before such welding commences the Contractor shall satisfy the Project Manager that the welders or welding operators are qualified in accordance with the requirements of the appropriate section of BS.4872 or other relevant Standard Specification approved by the Project Manager.

After scrutinizing the general arrangement and welding detail drawings, the Project Manager shall inform the Contractor of the stages at which inspection will be required. It shall be the Contractor's responsibility to notify the Project Manager when one or more of the inspection stages will be reached and no further work shall be carried out until the specified stage has passed the Project Manager's inspection.

In addition to the above, the Project Manager reserves the right to visit the Contractor's Works at any reasonable time during fabrication of the items of plant and to familiarize himself with the progress made and the quality of the work to date.

In the event of the Contractor wishing to make an alteration to any part of the weld preparation, he shall first submit to the Project Manager a copy of the revised drawing showing the amended preparation in detail and await confirmation of its acceptance or non-acceptance.

1.30 Galvanizing

Except where specified to the contrary, all iron and steel used in the construction of the Contract Works shall be galvanized after all sawing, shearing, drilling, punching, filling, bending and machining is completed.

Since the sites of Plants are closer to the sea all steel items used for erection should be galvanized. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. Galvanizing shall be applied by the hot dip process and, for all parts other than steel wires, shall consist of a coating of at least 610 grams of zinc per square meter of surface and shall withstand the tests set

out in BS.729. Steel tower materials shall be treated with Sodium Dichromate or Preton W20 solution after galvanizing to prevent the formation of white rust.

Special attention should be paid on galvanizing of foundation screws used in wind mast foundations. The galvanizing thickness of foundation screws shall be sufficient to last them for 20 years period buried under salty soil conditions near the sea (at environmental category C4 as defined in ISO 9223) .

The preparation for galvanizing and the galvanizing itself shall not distort or adversely affect the mechanical properties of the material. After galvanizing, holes shall be free from nodules of spelter.

All steel wires shall be galvanized by an approved process before stranding. The zinc shall be smooth, clean, of uniform thickness and free from defects and shall withstand the tests set out in BS.443. The requirements in respect of stranded steel buried counterpoise earthwire are given in Clause 2.5.

If any galvanized part is found to be imperfect it shall be replaced. The whole of the expense involved in the replacement of the imperfect part shall be borne by the Contractor.

The Contractor shall provide an instrument for checking galvanizing thickness, e.g. Elcometer, or otherwise agree with the Project Manager an approved method of testing galvanizing on site.

If, in the opinion of the Project Manager, the extent of damage found on Site to a galvanized part appears capable of repair, the Contractor may, after receiving such agreement, attempt to repair by approved methods. The agreement to attempt repair shall not bind the Project Manager to accept the repaired part when this is re-offered for inspection.

In the event that it is found that galvanized parts are subject to the formation of white rust or damage resulting from chemical contamination, during shipment or storage on Site, the Project Manager shall either;-

(a) approve a system of scrubbing and protective painting to be applied on Site, if in his opinion this is expedient,

or

(b) forthwith order that the affected parts shall be condemned and that all future shipments shall receive, before dispatch from the works, special dip or spray treatment to individual members to his approval without extra charge to the Employer.

Either of the above measures shall not be held as a cause for failure to meet the Plant Completion Dates.

1.31 Sub-Contracted Plant and Materials

Triplicate copies of all sub-contracted plant and material orders, including revisions thereto, shall be submitted to the Project Manager for approval at the time any such order is placed. Copies submitted shall be clearly marked on the first page with the reference and title stated in Clause 1.21 and a statement that the plant and materials shall be inspected by the Project Manager.

The Contractor shall also provide the Employer's representative on Site with names and details or local sub-contractors before such subcontracts are placed. The Project Manager reserves the right to withdraw his consent to local sub-contract arrangement if such are considered unsuitable, but consent shall not be unreasonably withheld.

1.32 Schematic Drawings

As soon as final configuration for Plant is approved the Contractor shall provide promptly a single line diagram summarizing equipment ratings, voltage, conductors or cable sizes, ratings of fuses, MCBs, MCCBs, RCCBs, surge protection devices and ratings, protective conductor ratings, metering details, network interconnection panel details, network earthing arrangements etc.

1.33 Layout Drawings

During the progress of the work the Contractor shall record on set of Survey Map transparencies to drawn to a suitable scale the exact position of power plant building, location of pergola for mounting PV arrays, selected wind support positions with cable routes, interconnecting line routes and other items to be constructed such as fence, water supply tanks, roads and sewage systems.

In a layout drawing of a power plant building the location of each equipment, wiring or cabling routes, position of fuses, breakers, RCCB and ventilation systems should be clearly indicated.

Separate drawings should be provided for power plant building wiring system and plumbing system together with the list of ratings and makes of equipment elected for installation.

The drawings and data included on the maps, profiles, sketches and any other information considered necessary for reference during the operation of the Contract, and shall be to the approval of the Project Manager, to whom facilities shall be given for examining such records during the progress of the work. The maps, sketches, profiles and schedules shall be prepared for the Project Manager, but will be in the charge of the Contractor until the completion of the particular Section of the work to which they refer.

1.34 Electricity Supply for Power Plant Building

Contractor shall provide single phase electricity supply for the power plant building and relevant expenses shall deem to be included in the design, supply and installation rates of the power plant building contained in the Schedules

1.35 Water Supply for Power Plant Building

Contractor shall provide a water tank and plumbing system to supply water for the power plant building. If water supply service is available the service connection shall be arranged by the contractor. Otherwise a well should be made and a water pump shall be provided. The relevant expenses shall deem to be included in the design, supply and installation rates of the power plant building contained in the Schedules.

1.36 Electricity and Water Supplies for Constructing Purposes

The Contractor shall make his own arrangements for electricity and water necessary for constructional purposes and all expenses shall be deemed covered by the several rates contained in the Schedules.

Any apparatus and provisions necessary for the distribution and use of such electricity and water must also be provided by the Contractor at his own expense.

The Contractor shall also make his own arrangements direct with other contractors for any such services, which they are prepared to provide.

1.37 Providing Communication Service for Remote Monitoring

The Contractor shall make his own arrangements for providing necessary communication service and equipment required for remote monitoring and controlling of the Plant. In case of low signal strength the contractor shall provide equipment to boost the local signal level or install a local antenna up to the maximum of 10m height to catch the signal. The required expenses shall be deemed covered by the several rates contained in the Schedules.

1.38 Contractor's Plant or Equipment

At the conclusion of the Contract, should it be desired to retain possession of all or any of the Contractor's plant or equipment the Employer shall be at liberty to do so upon paying for the same such price as shall, in case of difference, be fixed by the Project Manager.

1.39 Final Records

After all items of plant have been manufactured and erected a 35mm negative mounted on standard aperture card of each approved drawing shall be provided together with one true to scale on approved translucent material and six white print on heavy duty paper to show the details and arrangements of the plant as made and installed.

A soft copy consisting of Drawings in AutoCad format and calculations and documents in Microsoft Word or Excel formats shall be provided in six copies in Compact discs.

The following drawings and calculations will be required;-

a) The inventory of the installed equipment, their serial numbers, capacities, supplier addresses, test certificates and guarantee certificates.

b) Design calculations, member details, nut and bolt sizes and BOQ with other relevant design information for steel structures

c) Layout of the power plant building and pergola used for PV mounting

d) Single line diagram showing the complete Plant including equipment ratings, cable sizes, fuse sizes, ratings of MCB,MCCB and RCCBs installed, metering point, location and details of surge protection devices , earthing details of the system and equipment earthing details, details of outgoing feeder panels etc.

e) Layout drawing showing the positions of electrical equipment, fuses, MCBs ,MCCBs ,RCCB surge protection devices and actual clearances and maintenance zones etc.

f) Survey plan drawn to a scale showing all details of the land indicating positions of wind towers, power plant , pergola, cable routes , sewage system, fence details, etc.

g) Drawings calculations and design details of earthing system including earthwire sizes, clamps, position of joints, details of rods used and their positions etc.

h) Certified copies of test reports of all equipment including soil and concrete testing reports

i) Commissioning report for each individual items installed

j) Commissioning report for earthing system including wind tower earthing

k) Name plate details of all equipment connected

l) Operational manuals of each equipment installed

m) Maintenance manuals of each equipment installed

n) A list of spare parts for ten years trouble free operations. The list should include vendor contact addresses, telephone numbers, web addresses etc.

o) Necessary manuals, cables, passwords and software licensed to Employer of each installed equipment for data download, automation, protection setting programming etc.

p) Details of programmed protection settings and supporting relay coordination diagrams

q) Building wiring diagram, calculations and test report for electrical installation to guarantee that the installation complying with IET wiring regulations.

r) Details of battery disposal procedure

Final record copies shall be handed over before the issue of the Completion certificate.

1.40 General Power Plant Interconnection Requirements

The Employer will construct extensions of existing 400V or 11kV feeders required for power plant interconnection up to the power plant connecting point near the power plant building. The contractor shall provide necessary cables, wires, connectors of 11kV and lower voltage required for power plant output to connect with nearby 11kV or LT feeder.

The power interruption necessary for execution of connection works will be arranged by the Employer, but limited for daytime only. The rates are deemed to allow meeting any constrains.

All dismantled materials and equipment shall be delivered to the Employer's stores and handed over to the Project Manager.

1.41 Authorization of Documents

The following drawings and design reports shall be submitted to the Employer immediately after the Project Manager Approval.

a) Complete report of wind towers & foundation design calculations for each type of tower and their extensions.

b) Power plant building civil design & foundation calculation

c) Power plant building wiring design with calculations.

d) Power plant building plumbing design

e) PV panel mounting structure design with calculations

f) Generator foundation design with calculations

g) Transformer (if any) mounting arrangement design and calculation

h) Schematic drawing of the Plant indicating equipment rating, cable sizes, fuse sizes, protective equipment with their ratings.

i) Design of cable trenches

All the above mentioned drawings and design reports submitted to the Employer and approved by the Project Manager shall become the sole property of the Employer. The contractor shall transfer all the rights with respect to the above designs and drawings to the Employer so that the Employer can use them without any restrictions and conditions for his use in future.

1.42 Information to be Supplied with the Offer

Details with descriptive matter, catalogues indicating the drawing, ref. number and literature of the items offered in accordance with relevant clause of the standard specified including the following particulars shall be furnished with the offer.

a) Constructional features, materials used for components

b) Complete dimensional drawings

c) Certificate of type tests carried out in accordance with the specified standard by an acceptable testing authority. Test certificates should cover all the relevant tests as stated in the applicable standards.

d) Performance certificate with regard to manufacture, supply and utilizations of conductor, earth wire or accessory of similar type and design quoted.

e) The particulars requested in Employer's requirements

f) It is required to include a list of names and addresses of ten leading purchasers other than the country of origin (of similar items only) giving times of delivery and quantities supplied during the past five years.

g) Certificate issued by an independent International Organization to ensure compliance the ISO 9001:2008 standards by manufacturer.

Failure to furnish these particulars will result in the Bid being rejected.

1.43 Protection of the Environment and Adherence to the Environmental Act, Regulation and Other Guidelines.

The selected contractor is responsible for the full compliance with the following acts, regulations and/or guidelines with respect to the execution of this project.

- National Environmental Act No. 47 of 1980 including all the amendments.

The bidders also shall take into consideration the relevant costs that will be incurred, for the strict adherence to the environmental safeguard measures stipulated in the environmental approvals (if any) and the relevant documents forming part of such approvals obtained under the above acts/regulations/guidelines with respect to this project.

Chapter 2 – PV Panels, Inverters and Accessories

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Chapter 2 – PV Panels, Inverters and Accessories

2.1 General

The amount of solar power generation at each island measured at 400V busbar is presented in Clause 1 of Part A of Section 6 of the bidding document. The Contractor shall select equipment ratings according to the requirements given in Part A of Section 6 of the bid document. All the PV modules provided will be identical with the given specifications here.

The way of integrating the solar power generation with the Plants to be established is as following:

DC energy generated at PV panels are directed to inverters and the inverter output of 400V,50Hz , three phase, 4 wire, AC supply is integrated with 400V, 50Hz, AC, three phase, 4 wire system formed by several clusters made up of batteries and grid forming inverters. This connection is made at the cluster switch box. Cluster switch box is a switching facility to combine different energy sources i.e. solar, wind, battery and diesel generation together to form the hybrid system.

SPV panels, inverters and other main accessories used in solar energy systems are described here. All items shall have the characteristics as entered in the Technical Particulars & Guarantees in Employer's requirements.

2.2 Solar Photovoltaic Modules

The total solar PV array capacity should comprise of monocrystalline Bifacial Silicon standard modules and three phase string Inverters. The bidder has a freedom to select number of cells in PV module.

SPV modules shall have high transitivity, low iron content and anti-reflective structured tempered glass at front face, and back face with multilayer laminate of Tedlar material or similar premium quality encapsulation materials having superior UV and thermal properties (Glass to Glass PV Modules). Thin film modules are not acceptable.

The PV modules shall fulfil the requirements established in the main International Standards, in order to guarantee the electrical safety, the performance parameters and the photovoltaic module long- term durability. At least, the PV modules shall fulfil the latest versions of the following standards:

IEC 61215: Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements

IEC 61730-1, 2: Photovoltaic (PV) module safety qualification, Part 1: Requirements for construction, Part 2: Requirements for testing

IEC 61701: Salt mist corrosion testing of photovoltaic (PV) modules

IEC 62716: Photovoltaic (PV) modules - Ammonia corrosion testing

IEC 62804: Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon

- IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules

The photovoltaic modules must have been tested at a qualified institution (such as the European Solar Test Installation, TUV Rheinland or equivalent) and shall be certified according to the above referenced international standards. The Bidder shall submit a copy of the relevant certificates and type test certificates with the bid.

The Manufacturer shall be certified according to international Quality and environment Management System Standards ISO9001, ISO14001.

Individual modules shall be at least 400 Wp in power output.

PV module conversion efficiency should be equal to or greater than 20 % under at STC (Standard Test Condition).

PV panels shall be suitable to install at the vicinity of the sea.

Modules shall not require any positive or negative grounding.

The PV module shall perform satisfactorily in humidity up to 100% with Temperature between –10^{o}C to + 80 ^{o}C.

Other general requirement for the PV modules and Plants shall be the following:

a) Raw materials (solar Cells) and technology employed in the module production processes shall be certified and a certificate giving details of major materials i.e. cells, Glass, back sheet, their makes and data sheets to be submitted for the modules being supplied by the bidder.

b) The rated output power of any supplied module shall have a positive tolerance of + 5%.

c) The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary more than 3 (three) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.

d) Except where specified, the front module surface shall consist of impact resistant, low-iron and high-transmission toughened glass.

e) The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP67 rated.

f) Necessary I-V curves at 25^{0}C, 50^{0}C, 75^{0}C and at NOCT (Nominal Operating Cell Temperature) are required to be furnished.

g) The modules will have a power warranty of at least 12 years at 90% nominal module power output and 25 years at 85% of minimum output power, under the operating conditions at the sites. The modules will be warranted against physical defects for a period of at least 25

years following installation. A statement of warranties in effect for the proposed module type must be provided.

h) Each PV module to be used is desired to have RFID (Radio Frequency Identification) or barcode identification system.

i) The modules can bear wind loads of at least 2400Pa

j) In order to guarantee minimum generation loss due to increase in module temperature, the Temperature coefficient of Pmax should not be lower than -0.35%/^{0}C.

k) All panels should be provided with identification tag to trace information on design and manufacturer of solar cells and modules.

l) By-pass diodes for shading effect reduction will be required and they will be located in the PV module junction box. The bypass diodes should be replaceable without replacing the whole module.

m) All the cables used in the DC bus of the solar system will be suitable rated solar cable.

a) All the DC interconnections will be carried out using appropriate DC connectors designed for solar photovoltaic applications. PV DC connectors for string interconnection shall be of the same brand and type as used by the PV module manufacturer. In no case connectors of different brands are to be used in the same connection (male –female). Under no circumstances it is allowed to cut the PV module cables and to install other than the original connectors. DC connectors shall be IP67. The connectors used must comply with IEC- 50521. The physical warranty for the modules will include the connectors and corrosion of connectors causing increased voltage drops during the warranty period will be deemed as sufficient reason for warranty replacement

The bidder shall include in the bid the following information on PV panels:

- Voc, Isc, Impp, Vmpp and Wp at standard conditions
- Temperature coefficient (%/°C)
- The IV curves for 400, 600, 800 and 1000 W/m2 solar inputs
- Type and number of cells per module
- Length of included connecting wires
- Physical size and weight
- Type test certificates mentioned above
- Warranty certificate

The minimum information required which will be shown on the manufacturer´s label attached to each module, will be the following:

- Manufacturer´s name
- Model identification

- Serial number
- Rated power at STC
- Voc and Isc
- Date and country of manufacture
- Date and year of obtaining IEC PV module qualification certificate

2.3 Mounting Structure

The material and design of the PV panel mounting structure shall satisfy the following requirements.

a) Wherever required, suitable number of PV panel structures shall be provided. PV panels shall be mounted on roofs of all buildings in the proposed power plant. If any balance amount, then that amount shall be fixed above the HFL (High Flood Level) with suitable anticorrosive mounting structure. Minimum distance to the bottom of panel from high flood level is 100mm. However, minimum distance to the bottom of the panel shall not be less than 900mm.

Contractor shall decide roof/structure type and inclination (will be decided by IA) depending on building requirement. However, solar panel inclination shall be decided such a way that the maximum possible power can be extracted at the particular location.

b) The array structures shall be of flat-plate design either I or L sections

c) Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. It is recommended to use anodized Aluminum. Galvanized steel is not allowed. Structures shall be supplied complete with all members to be compatible for allowing easy installation at the rooftop/structure.

d) The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the rooftop columns properly. All nuts and bolts shall be of very good quality stainless steel.

e) The structures shall be designed to allow easy replacement of any module and can be either designed to transfer point loads on the roof top or UDL as per site conditions.

f) Each structure shall have a provision to manually adjust tilt angle along a north south axis as per the site conditions

g) Each panel frame structure shall be so fabricated as to be fixed on the rooftop/column/wall structures. The structure should be capable of withstanding a wind load of 200 km/h after grouting & installation. Grouting material for SPV structure shall be as per M15 (1:2:4) concrete specification.

h) The structures shall be designed for simple mechanical and electrical installation. There shall be no requirement of welding or complex machinery at the installation site. If prior civil work or support platform is absolutely essential to install the structures, the supplier shall clearly and unambiguously communicate such requirements along with their specifications in the bid.

i) Each panel shall be attached to the array mounting super-structure in four places using the clamp- mount method on the module frames, and the panel shall not itself form part of the support structure, to prevent torsional forces on the panel. The mounting structure and clamping arrangement shall be sufficiently versatile to accommodate the panels.

j) The clamps for fixing the modules onto the structure should be anodised aluminium with stainless steel bolts, and should be tamper-proof and require a unique allen key or similar device for loosening

k) The array support frames and mounting superstructure shall be provided in several identical sections (or sub-arrays) to allow for any thermal expansions and contractions.

l) Repairing damage made: Any required welding, holes drilled or surface damage to the structure after galvanising shall berepaired with Galvadip™, Adensotape™ or Petrotape™ systems, or other approved substantially equivalent cold-galvanising treatments. Any holes made in the material shall be sealed and made waterproof with approved UV resistant material.

m) For ease of installation and testing, the best practice approach for earthing modules together is to use separate earth frame flange grounding using stainless bolts, onto earth conductors providing earth continuity

n) The supplier shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. Such details shall include, but not limited to, the following;

i. Determination of true south at the site;
ii. Array tilt angle to the horizontal, with permitted tolerance;
iii. Details with drawings for fixing the modules;
iv. Details with drawings of fixing the junction/terminal boxes;
v. Interconnection details inside the junction/terminal boxes;
vi. Structure installation details and drawings;
vii. Electrical grounding (earthing);
viii. Inter-panel/Inter-row distances with allowed tolerances and Safety precautions to be taken.

2.4 PV-Inverter

The inverters shall be designed to be able to transmit the maximum output of the PV Plant at all possible ambient temperatures and local conditions. The PV-Inverter required shall convert DC power produced by PV modules in to AC power and adjust the voltage & frequency levels to suit the local grid conditions. The PV-Inverter with grid interactive shall feed power to the TT type three phase, 400V, AC distribution network.

a) Common Technical Specification (The capacity of the PV inverter shall be 100kW or less):

i. Control Type: Voltage source, microprocessor assisted, MPPT output regulation

ii. Rated output voltage: 3 phase, 400 V ac (+12.5 %, - 20 % V ac)

iii. Grid configuration: TT, 3 phase 4 wire system

iv. Topology: transformerless

v. Frequency: 50 Hz (+5 Hz, -6 Hz). Inverter shall have frequency-dependent active power limitation and grid management service

vi. PV-Inverter /Array Size Ratio=1

vii. Minimum Input bays: 2 Mpp inputs

viii. Maximum Input voltage of 1000V DC.

ix. Nominal Power : Depend on the project requirement

x. Total Harmonic Distortion : less than 4%

xi. Inverter Housing : PV-Inverter shall be IP 65 degree of ingress protection and corrosion prevention due to marine and suitable for salty and tropical environment

xii. Efficiency : 98 % and above at full load

xiii. Power Control : MPPT (preferably 300V to 800V DC)

xiv. Active Power Management Requirements

DC power regulation:

Inverter Temperature Derating: In order to avoid the grid disconnection, the inverters shall implement a temperature derating, reducing the power output with the temperature.

Overload: The inverter shall not switch off under overload-conditions arising from high DC power inputs

Dynamic 3 phase balancing of power output is required

Remote Power reduction or power limiting capability via software from centralized plant control is required.

Frequency–dependent active power reduction mode for over frequency conditions is required. This feature must be configurable in the inverter, allowing a local or remote mode, in order to integrate the PV field converter with the Battery converter.

xv. Reactive Power Management Requirements

The PV inverters shall be able to follow reactive power references coming from the power plant controller within their power capability curve and/or to dynamically adjust their power factor setpoint.

The PV inverters shall implement a Voltage Regulation mechanism to be able to control the grid voltage generating or consuming reactive power if necessary.

Maximum response time for voltage regulation shall be 1 second.

xvi. Operating temperature Range : 0 to 60 deg C

xvii. Over voltage category in accordance with IEC 60664-1: II for DC & III for AC

xviii. Noise level : <55dB (A)

xix. Cooling concept: Convection

xx. Climatic category according to IEC 30721-3-3: 4K4H

b) Other Important Parameters of the PV-Inverter

i. Mains (Grid) over-under voltage and frequency protection

ii. Full proof protection against Islanding.

iii. DC reverse polarity protection

iv. Protection against reverse currents

v. All pole sensitive residual current monitoring device should be available for trasformerless PV-Inverter

vi. Included authentic tracking of the solar array's maximum power operation voltage (MPPT).

vii. Array ground fault detection.

viii. LCD and piezoelectric keypad operator interface Menu driven

ix. Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.

x. MOV type surge arresters of type II on AC and DC terminals for over voltage protection from lightning-induced surges.

xi. All parameters should be accessible through an industrial standard communication link.

xii. Inverter over loading capacity shall be 150% of continuous rating for 60 second.

c) The PV-Inverter shall be self-commuted and shall utilize a circuit topology and components suitable for meeting the specifications listed above at high conversion efficiency and with high reliability.

d) The PV-Inverter shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line-to-line fault currents and line-to ground fault currents. PV-Inverters shall comply with the requirements defined in IEEE 1547.

e) The PV-Inverter shall be able to withstand an unbalanced output load to the extent of 30 %

f) The PV-Inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PV-Inverter component failure or from parameters beyond the PV-Inverter's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PV-Inverter front panel to cause the PV-Inverter to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PV-Inverter, including commutation failure, shall be

cleared by the PV-Inverter protective devices and not by the existing site utility grid service circuit breaker.

g) The PV-Inverter shall go to the shutdown / standby mode with its contacts open under the following conditions before attempting and automatic restart after an appropriate time delay in insufficient solar power output.

i) Utility-Grid Over or Under Voltage

The PV-Inverter shall restart after an over or under voltage shutdown when the utility grid voltage has returned to within limits for a minimum of two minutes.

ii) Utility-Grid Over or Under Frequency

The PV-Inverter shall restart after an over or under frequency shutdown when the utility grid voltage has returned to the within limits for minimum of two minutes. The permissible level of under/over voltage and under/over grid frequency is to be specified by the bidder.

h) The PV-Inverter generated harmonics measured at the point of connection to the utility services when operating at the rated power shall not exceed a total harmonic current distortion of 4%, a single frequency current distortion of 4% and single frequency voltage distortion of 1% when the first through the fiftieth integer harmonics of 30 Hz are considered.

i) The PV-Inverter Power factor at the point of utility service connection shall be 0.8 lagging or leading when operating at above 25% of the rated output, but may be less than 0.8 lagging below 25% of the rated output.

j) The high voltage and power circuits of the PV-Inverter shall be separated from the low- voltage and control circuits. The internal copper wiring of the PV-Inverter shall have flame resistant insulation. Use of PVC is not acceptable. All conductors shall be made of standard copper.

k) The PV-Inverter shall withstand a high voltage test of 2000 V rms, between either the input or the output terminals and the enclosure (chassis).

l) Full protection against accidental open circuit and reverse polarity at the input shall be provided.

m) The PV-Inverter shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the Facility in which the PV-Inverter is housed.

n) The PV-Inverter shall have an appropriate display on the front panel to display the instantaneous AC power output and the DC voltage, current and power input. Each of these measurement displays shall have an accuracy of 1 percent of full scale or better. The display shall be visible from outside the PV-Inverter enclosure. Operational status of the PV-Inverter, alarms, trouble indicators and AC and DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front of the PV-Inverter enclosure.

o) PV-Inverter should support remote monitoring and controlling software provided under this project and compatible Communication protocols with networking facilities shall be available.

p) Electrical safety, earthing and protection

i. Internal Faults: In built protection for internal faults including excess temperature, commutation failure, overload and cooling fan failure (if fitted) is obligatory.

ii. Galvanic Isolation: Galvanic Isolation is required to avoid any DC component being injected into the grid and the potential for AC components appearing at the array.

iii. Over Voltage Protection: Over Voltage Protection against atmospheric lightning discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the PV-Inverter, operational errors and switching transients.

iv. Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system. The PV-Inverter shall include an easily accessible emergency OFF button located at an appropriate position on the unit.

q) The PV-Inverter enclosure shall be weatherproof and capable of surviving climatic changes and should keep the PV-Inverter intact under all conditions where it will be kept. The PV-Inverter shall be located indoor and should be either wall / pad mounted. Moisture condensation and entry of rodents and insects shall be prevented in the PV-Inverter enclosure.

r) In the design and fabrication of the PV-Inverter the site temperature (5° to 60°C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking and thermal for blocking diodes and similar components.

s) Factory Testing:

i. The PV-Inverter shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment

ii. Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

iii. Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

iv. Operation of startup, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the PV-Inverter and response to control signals shall also be tested and demonstrated.

v. Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by the Purchaser. Tests may be performed at 25,30,75 and 100 percent of the rated nominal power.

vi. A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted.

t) Maximum Power Point Tracker (MPPT)

u) Maximum power point tracker shall be integrated in the PV-Inverter to maximize energy drawn from the array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be mentioned. The MPPT must have provision (.manual setting) for constant voltage operation.

v) Disconnection and Islanding

w) Disconnection of the PV generator in the event of loss of the main grid supply is to be achieved by in built protection within the power conditioner. This may be achieved through rate of change of current, phase angle, unbalanced voltage or reactive load variants.

x) Operation outside the limits of power quality as described in the technical data sheet should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are: Neutral voltage displacement Over Current, Earth fault And Reverse Power. In case of the above, cases, tripping time should be less than (15 seconds. Response time in case of grid failure due to switch off or failure based shut down should be well within 5 seconds.

y) PV-Inverter for PV array shall be compatible with grid forming inverters used in the Plant.

z) Product warranty for inverters should be at least 10 years. In addition it should be possible to purchase an extended warranty up to 20 years.

2.5 Array Junction Box, Main Junction Box

The junction boxes are to be provided in the PV yard for termination of connecting cables. The J. Boxes shall be made of FRP/Powder Coated Aluminium with full dust, water & vermin proof arrangement. All wires/cables must be terminated through cable lugs. The J.Bs shall be such that input & output termination can be made through suitable cable glands.

All modules in the same electrical string/subarray shall be the same tilt angle and orientation. The electrical interconnection among strings with different characteristics will not be allowed.

The PV modules and associated wiring up to the grid connect PV-inverters shall be installed in accordance with IEC Technical Specification IEC/TS 62548:2013(E). This Technical Specification sets out design requirements for photovoltaic (PV) arrays including D.C. array wiring, electrical protection devices, and all switching and earthing provisions. In particular:

a) DC cables up to the string combiner boxes, or PV-inverters, or solar charge controllers will be single core.
b) Cables shall be UV-resistant, double insulated, ozone-resistant, temperature resistant, solar type cable and an equivalent to 4 or 6 mm^2 solar cable. The solar cables shall comply with:
    - PV1-F requirements;
    - UL 4703; or

- VDE-AR-E 2283-4.

c) Although the DC cable is UV resistant, all wiring shall be protected from direct sunlight either by means of appropriately rated protective sleeves or channelling. Care should be taken that the DC cables are not routed through closed spaces where temperatures increase due to direct sunlight on the channelling.
d) All cables/wiring and conduits shall securely fixed in place to minimise any movement of the cable.
e) All conduit exposed to daylight shall be UV stabilised.
f) The maximum design voltage drop in the DC cables from the modules to the inverter input shall be <1.5% at STC.
g) Short-circuit and earth-fault safety shall be ensured through appropriate installation layout.
h) The function of the string combiner box shall be to connect different PV strings in parallel and to house an inline appropriately rated (D.C. voltage and current as per IEC/TS62548 (E)) double pole series connected D.C switch disconnector in both the positive and negative outgoing conductor.
i) For each array connected to an individual MPPT or MPPT within a PV-Inverter, the string combiner box shall contain Type 2 surge arrestors between the positive conductor and earth and the negative conductor and earth.
j) If string protection is required as per the requirements on IEC/TS62548 (E), they should also be housed in the string combiner box.
k) All DC plugs an only be mated (joined) with those of the same type from the same manufacturer.
l) The wiring from the junction box or array to the power house or PV-Inverter should be sized to result in voltage drops under 2% of the nominal operating voltage (when the PV array is operating at STC conditions)
m) The wiring from the junction box or array, to the power house or PV-Inverter should be sized in accordance with the rating of the circuit breaker located at the input of the solar charge controller if available.

Copper bus bars/terminal blocks shall be housed in the junction box with suitable termination threads of spelter.

Boxes shall conform to IP65 standards and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry.

Single compression cable glands shall be incorporated. There shall be a provision of earthing.

Suitable markings should be provided on the bus bar for easy identification, and cable ferrules shall be fitted at the cable termination points for identification.

2.6 Other Accessories

2.7 There shall be a DC, 2P, MCB of appropriate rating at before the PV-Inverter input connection for isolation purposes.Weather Station – all in one weather station

Wind speed , temperature, irradiance, ambient temperature, pyranometer, wind direction back PV module temperature, rain gauge

DC surge protector of type II, 12.5kA and protection voltage of 0.5kV shall be fixed near the inverter DC input terminal.

There shall be a AC, 4P, MCB of appropriate rating at place where the inverter output is connected to the output busbar.

AC surge protector of type II, 10kA and protection voltage of 1.5kV shall be fixed near the inverter AC output terminal.

All AC power cable connections must be made using PVC insulated and PVC sheathed 600/1000V Cu cables of appropriate sizes, as per BS-6346 standards. All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in underground trenches and GL trays with covers for protection.

Fast acting semiconductor type current limiting fuses shall be used at the main busbar to protect from the grid short circuit contribution.

2.8 Manufacturing Experience

Manufacture shall have minimum of 10 year experience in Manufacturing PV Modules, PV inverters and Accessories. Further, the manufacturer shall have minimum of five (5) year experience in supplying PV Modules, PV inverters and Accessories to countries other than the country of manufacturer.

Manufacture shall provide proof document to prove his experience in accordance with above criteria.

2.9 Quality Assurance

The manufacturer shall possess ISO 9001:2008 or latest of Quality Assurance Certifications for the manufacture of PV Modules, PV inverters and Accessories for the plants where the manufacture of PV Modules, PV inverters and Accessories is done. Bidders shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

2.10 Test Certificates

The inverters should be tested and certified by a qualified institution (such as TUV Rheinland or equivalent) and CE-marked and in compliance with the applicable standards IEC 61000-6-2:2005; IEC 61000-6-4:2006 and IEEE 1547.

A copy of the certification shall be presented with the bid.

2.11 Inspection and Testing

The contractor shall make necessary arrangements for inspection of the equipment by three (3) Engineers appointed by Implementing Agency (IA) and also to carry out necessary acceptance/sample tests in accordance with the relevant International Standards of following material and equipment offered.

a) Solar Photovoltaic Modules

b) PV Inverters

The contractor shall make necessary arrangements to observe the quality assurance system established in the factory of manufacturing.

The cost of inspection and testing shall be included in rates offered for PV Modules, PV inverters and Accessories.

2.12 Information to be submitted with the technical bid

Details with descriptive matter, catalogues indicating drawings, reference numbers and the literature of the items offered in accordance with the relevant cause of the specification including the following particulars shall be forwarded with the technical bid

.

(a) PV panels: . Performance warranty Certificate
- Voc, Isc, Impp, Vmpp and Wp at standard conditions
- Temperature coefficient (%/°C)
- The IV curves for 400, 600, 800 and 1000 W/m2 solar inputs
- Type and number of cells per module
- Length of included connecting wires
- Physical size and weight
- Type test certificates mentioned in Section 2.2 above.
- Certificate issued by an independent international organization to ensure compliance the ISO 9001:2008 standards by manufactures.
- Information to justify CE certification

(b) Mounting structures
- Material details
- Details with drawings for fixing the modules;
- Details with drawings of fixing the junction/terminal boxes;
- Interconnection details inside the junction/terminal boxes;
- Structure installation details and drawings;

(c) PV inverters
- Inverter voltages, capacity, frequency, MPP range
- Controlling and protection features
- Details of enclosure and mounting information
- Type test certificates mentioned in Section 2.4 above.
- Certificate issued by an independent international organization to ensure compliance the ISO 9001:2008 standards by manufactures
- Information to justify CE certification

Performance warranty cirtificate

(d) Duly filled Table 2.1 of Guaranteed Technical Particulars given in Part D-Supplementary Information of the Bid Document

Chapter 3 – Diesel Generator and Accessories

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Chapter 3 – Diesel Generator and Accessories

3.1 General

The amount of diesel power generation at each island measured at 400V busbar is presented in Clause 1 of Part A of Section 6 of the bidding document. The Contractor shall select equipment ratings according to the requirements given in Part A of Section 6 of the bid document. The specification of the diesel generators are given here.

The way of integrating the diesel power generation with the Plants to be established is as following:

Diesel generator shall be operated in parallel with PV generation, wind generation and grid formed by battery-inverter system. The controller of the system will initiate on/off commands and loading set point for the generator depending on the requirements.

Diesel generator output of 400V, 50Hz, three phases, 4 wire, AC supply is connected to the busbar at the Cluster Switch box. Diesel power is integrated with 400V, 50Hz, AC, three phase 4 wire system formed by several clusters of batteries together with grid forming inverters. This connection is made at the Cluster Switch box. Cluster Switch box is a switching Facility to combine different energy sources i.e. solar, wind, battery and diesel generation together to provide the electricity demand of the distribution network. Diesel generator shall be connected automatically when energy generated by renewable sources is not adequate to meet the demand and for charging of batteries used in the cluster system.

Diesel generator shall be able to provide the entire demand when renewable energy generation is not significant.

The Diesel Generators shall run in parallel to the PV Plant. In order to control the whole system (PV Inverter, BPCS & Diesel Generator), the Diesel Generator shall implement a Modbus RTU communications protocol, with the following parameters, but no tlimited to:

- Output Voltage
- Output Current
- Frequency
- Output Power
- Diesel level
- Diesel consumption
- RPMs
- Auto and manual Synchronize panel
- Generator Status / Alarms & Errors

Diesel generator and other main accessories used in hybrid Plants are described here. All items shall have the characteristics as entered in the Technical Particulars & Guarantees in Employer's requirements.

3.2 Diesel Generator Characteristics and Controllers

The diesel generator required shall generate AC power and adjust the voltage & frequency levels to suit the local grid conditions. The generator shall feed power to the TT type three phase ,4 wire , 400V, 50Hz, AC distribution network formed by battery –inverter system.

3.2.1 Common Technical Specification for Diesel Generators

This specification covers all diesel generators used in the Plant. The power ratings will be different for each island and depends on the system design. The other requirements are given below.

3.2.2 Genset specification

i. Power Capacity kW/kVA : Prime rating at Section 6 Part A or as decided at the design

ii. Rated voltage/frequency : three phase 400V at 50Hz

iii. Manufacturing Standards: ISO8528; ISO3046; BS5000, IEC 60034, BS 4999 , BSEN 61000, UTE NFC51.111, VDE 0530, BS4999/5000, NEMA MG 1-33

iv. Life time : 20,000 hours or 10 years

3.2.3 Engine specification

i. Rated Power /kW : Sufficient power to cater electrical requirements

ii. Engine structure: vertical (or V type) in-line, 4 stroke, direct injection

iii. Aspiration: Turbocharged

iv. Cooling system: Closed cycle water cooled

v. Fuel system: rotary fuel injection pump

vi. Fuel: Auto Diesel

vii. Maximum fuel consumption: 0.025kg/kWh

viii. Lube oil type: shall be available in local market

ix. Minimum Lube oil replacement duration: to be mentioned

x. Speed governing: electronically speed governing with droop setting adjustment.

xi. Starting mode: by 12V batteries

3.2.4 Alternator specification

i. Alternator type : three phase Synchronous generator

ii. Voltage control & excitation: AVR regulation with brushless excitation

iii. Protection Class : IP23 protection grade

iv. Insulation class : Class H

v. The generators are air cooled, whereby the air is taken from the engine room by a ventilator on the non-driven side of the generator. Filter elements shall be reusable after cleaning.

vi. Steady state voltage regulation: <±0.5%

vii. Instant voltage regulation: -15% and +20%

viii. The governor shall be capable of maintaining operating conditions specified herein. The frequency shall not vary more than 1% under any condition at generator loads from 0% to 100%. Speed droop shall be adjustable during operation from zero to 5%. For regular engine load test runs the governor shall maintain stable parallel operation without power oscillations..

ix. Wave distortion: <5%

x. Voltage / frequency fluctuation: <=0.5%

xi. AVR self-regulated, voltage regulation rate: <=+- 1%

xii. Radio interference restraining accords with stipulation of VDE0875-N and ISO8528

xiii. Power factor: 0.8 lagging

xiv. Connection type: 3 phase , 4 wire , Y type

xv. Starting mode : by 12V batteries

xvi. Features : Brushless excitation and AVR regulation with power factor control, provision for manual voltage regulator, IP21 protection grade

xvii. Electrical Efficiency : >90%

3.2.5 Additional Specifications

a) Ratings should be defined at Altitude <100m and ambient temperature <40 °C. These ratings are applicable for supplying continuous electrical power (at variable load) in lieu of commercially purchased power. There is no limitation to the annual hours of operation and can supply 10% overload power for 1 hour in 12 hours.

b) Generator sets shall go through 1 hour load test for running 0%, 25%, 50%,75%, 100% and 110% load before dispatch, all protective devices, control functions shall be simulated ,checked, proved and then passed for dispatch. A test certificate shall be provided.

c) Control panel shall have an emergency stop button.

d) Control panel shall be equipped with measuring, metering and monitoring equipment: at least the following meters: frequency meter, voltmeter and selector switch (or 3 voltmeter per phase), 3 ammeters per phase switch Genset kVA; Genset kW; Output Capacity; Output kWh; Power Factor, hour run meter.

e) Controller shall have key start and auto start, shut down capability Facility and NFPA 110 (Standard for emergency and standby power systems) - level 1 compliance.

f) Generator shall be equipped with all necessary sensors for monitoring, control and safety of the gen-set. The controller shall have Facilities to monitor engine temperature and provides warning/shutdown at high engine temperature, Monitor engine speed and warning/shutdown at under/over speed, Monitor engine battery voltage and provides warning/shutdown at high/low battery voltage, Monitor oil pressure or level and provides warning/shutdown at low oil pressure, Monitor alternator frequency, voltage and warning/shutdown at under/over frequency and high/low voltage. Warning system shall have an alarm output with recorder at abnormal operations.

g) Controller shall have fully automatic and manual synchronizing Facility. Synchronizing or Synchronism- Check Device shall be incorporated. The genset should be equipped with remote automatic start/stop.

h) The controller shall guarantee system integration (automatic start up and shut down capability) and remote communication. The controller shall support Modbus protocol and shall support remote monitoring and system diagnostic through remote communication via network or modem.

i) There shall be digital interface for reading of all the diesel generator sensors installed and the operational data of each diesel generator, and for direct connection to local SCADA and the Internet

j) The governor shall be capable of maintaining operating conditions specified herein. The frequency shall not vary more than 1% under any condition at generator loads from 0% to 100%.Speed droop shall be adjustable during operation from zero to 5%.For regular engine load test runs the governor shall maintain stable parallel operation without power oscillations.

k) Noise level shall be acceptable for near-by residential areas. Generator shall be housed in a sound proof canopy. At boundaries the sound level shall be 55 dB(day) , 45 dB (Night), with +3dB tolerances. Inside the Generator House - 60 dB(day) , 45 dB (Night), with +5dB (day), +3dB(Night) tolerances.

l) The generator shall have a heavy-duty steel base frame which includes lifting and mounting points. A fuel tank sufficient to operate the generator for 24 hours shall be integrated in the base frame and automatic fuel filling kit shall be incorporated. A level sensor for the fuel tank shall be provided. Rubber pad mountings shall be fitted between the base and the engine/generator assembly in order to isolate the vibrations generated by the rotating parts.

m) A fully rated UL and CSA certified mainline 4P circuit breaker shall be included to switch and protect the electrical load. It shall be fitted in an integral metal sheet enclosure. The wire connections are located directly below the circuit breaker.

n) Full protection against reverse power shall be provided.

o) Since the generator has to be operated near the sea, the alternator shall be protected with Coastal Insulation Protection (CIP).

p) Diesel generators for Plants shall be compatible with grid forming inverters used in Plants.

q) The alternator shall have anti-condensation heaters

r) A warranty of 24 months or 5000 running hours whichever comes first shall be provided for Diesel generator.

s) The manufacturer shall have minimum of 10 years' experience in manufacturing diesel generator in the capacity range 100 kVA to 500 kVA.

t) The manufacturer shall poses ISO 9001:2008 quality assurance certificate for manufacturing diesel generator in the capacity range 100 kVA to 500 kVA.

u) The local agent's workshop shall have ISO 9001:2008 quality assurance certifications and professional technical staff comprises of a Mechanical Engineer and technical supervisor for past three years.

v) The Diesel Generator offered shall be capable of functioning continuously at low loads (of approximately 25%), without causing excessive sediments in valves, pistons, etc. of the diesel engines

w) The world-bank regulations for exhaust-gas emission shall be followed – "Environmental, Health, and Safety Guidelines for Thermal Power Plants, December 19, 2008".

x) Working platforms dependent on the gen-set size have to be installed at the level of cylinder-heads. The working-platforms must be stable and must allow all necessary maintenance- and as well heavy repair-work.

y) All enclosures and materials subject to corrosion including exterior equipment surfaces and structural steel work shall be protected with suitable coating systems. Protection systems shall generally to be the most stringent international standards with exposure classed as "high".

3.3 Other Requirement and Accessories

The generator neutral shall be properly grounded.

The metal parts of the generator enclosure, control panel, fuel tank etc shall be properly grounded.

All pipe installation shall be underground.

All Cables shall be installed in cable trenches or on cable trays.

Cable connections must be made using PVC insulated and PVC sheathed 600/1000V Cu cables of appropriate sizes, as per BS-6346 standards. All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in GL trays with covers for protection.

AC, 4 Pole MCCB shall be installed at the entrance of the outgoing conductors from the generator for isolation purposes.

If more than one generator is to be installed at the same premises, the individual generator output shall be connected to the common busbar of adequate capacity and then the busbar output shall be connected to the appropriate bay at the Cluster Switch box. At similar instances, an additional AC, 4 Pole MCCB shall be installed at the entrance of the outgoing conductors from the busbar.

Fast acting semiconductor type current limiting fuses shall be used at the main busbar to protect from the grid short circuit contribution.

Contractor shall provide three copies of Operation and Maintenance manual.

Contractor shall be provided the following drawings and report at the installation stage and it is necessary to get the prior approval of Project Manager.

- A list of all equipment to be installed, together with principle operating characteristics.
- Foundation Drawings
- General arrangement drawings, Assembly drawings, plant layout, pipe work and erection instructions.
- Wiring diagrams, schematic diagrams for equipment modules and systems
- Single line logic diagram for all control systems
- Cable block diagrams and cable route drawings

3.4 Information to be submitted with the technical bid

Details with descriptive matter, catalogues, indicating drawings, reference numbers and the literature of the items offered in accordance with the relevant clause of the specification including the following particulars shall be forwarded with the technical bid

(a) General information of genset

i Manufacturer's technical literature for engine.

ii. Manufacturer's technical literature for alternator.

iii. Details of synchronization, voltage regulation and governor functioning capabilities

v. Details of protection and control features.

vi. List of essential spares and confirmation from the manufacturer about availability of them for next 10 years period.

v. Certificate of compliance to the technical specifications and commercial conditions.

vi. Certificate issued by an independent international organization to ensure compliance of ISO 9001:2008 standards by manufactures.

vii A copy of warranty certificate.

viii Information to justify CE certification

(b) Duly filled Table 2.2 of Guaranteed Technical Particulars given in Part D-Supplementary Information of the Bid Document

Chapter 4 – Battery Bank, Grid Forming Inverters and Accessories

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Chapter 4 – Battery Bank, Grid Forming Inverters and Accessories

4.1 General

Battery bank is used for storing energy generated by wind and solar in each hybrid system. Additionally the battery bank and grid forming inverters shall be able to make a 400V,50Hz, Three phase, 4 wire distribution system to connect other sources such as diesel , wind and PV generation. The amount of battery storage capacity at each island measured at 400V busbar is presented in Clause 1 of Part A of Section 6 of the bidding document. The battery capacities shall be defined for 100 % charge conditions and standard temperature 25° C The Contractor shall select equipment ratings according to the requirements given in Part A of Section 6 of the bid document. The specification for battery energy storage is presented here.

.The way of integrating the energy storage in the battery bank with the Plants to be established is as following:

The energy storage system operates as a one master cluster and several slave cluster systems. Each cluster consists of a battery bank and a grid forming inverter. The failure of one unit shall not disturb the demand supply. Energy stored at battery bank is directed to the grid forming inverters. Several similar clusters are integrated together to form a three phase, 400V, 50Hz, 4 wire, AC system. Several parallel clusters can be connected to increase the capacity of the storage system. The resulting AC system is connected to the busbar at the Cluster Switch box. Cluster Switch box is a switching facility to combine different energy sources i.e. solar, wind, battery and diesel generation together to provide the electricity demand of the distribution network. At occasions of low energy supply from renewable sources, batteries shall be able to provide the customer demand totally or partially. Batteries shall be charged by diesel, wind and PV sources. Battery –inverter system shall be able to respond sudden load fluctuations in the system to maintain grid stability.

Battery bank, grid forming inverters and other main accessories used in energy storage systems are described here.

4.2 Batteries

Details of the battery bank are given below. Battery capacity (kWh) and peak power capacity (kW) can be decided to match with the total storage capacity requirement calculated for each island at the design stage.

The most important parameters of the battery system are the discharge power and the durability of the system. The bidder shall propose the most suitable solutions based on Li-ion/LFP batteries to achieve at least the specified kW discharge power as specified for individual islands in Section 6.0 paragraph 2.5.1. Bidder shall select the most suitable product to meet the rated and peak discharge power with the lowest kWh installed

The Li-Ion/LFP batteries will fulfil requirements established in the main International Standards, in order to guarantee the electrical safety, the performance and long-term durability. At least, the batteries will fulfil the latest versions of the following standards, in the applicable fields:

IEC 62133- Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications

IEC 61427-1, 2-Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application, Part 2: On-grid applications

IEC 61960-Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications

IEEE 1375-Guide for the protection of stationary battery systems

EN 50272-2-Safety requirements for secondary batteries and battery installations

Battery type: Li-ion/LFP, maintenance free, sealed, rechargeable batteries with minimum fire risk

Cycle life : 6000 Cycles at 80% DOD

Expected calendar life: 15 years

Enclosure: Indoor-rated steel box with removable lid, IP 21

Rated voltage shall be decided by the designer.

Maximum Charging/Discharging temperature: 0ºC to +45ºC

The battery system shall be as free of maintenance as possible. The bidder shall inform about the requirement of some kind of preventive maintenance scheduling and the impact of these labours on the warranty terms and conditions of the system. The bidder shall also inform about the indicated personnel to perform the above mentioned maintenance tasks (manufacturer, certified subbidder, etc.)

It is essential to verify that the battery bank is compatible with the grid forming inverter. The bidder shall include the certificate issued by Grid Forming Inverter manufacture regarding the compatibility of the selected battery type.

Charging and discharging rate of batteries shall be decided for responding them at the sudden active power fluctuations in the system to maintain grid stability.

Battery terminals shall be covered and string connectors shall be insulated.

There shall be facilities to increase the battery bank capacity in the future by adding more batteries to the existing storage system.

Each battery string cable shall be protected by a suitably rated fuse or non-polarized circuit breaker. The switch and protection equipment shall be mounted as close as possible to the battery string.

Lithium-ion battery systems shall have a sophisticated battery management system (BMS).In BMS, Facilities shall be available for (a) measuring the battery state parameters like, individual cell voltages, pack current and temperature; (b) Triggering alarms in case of abnormal conditions or even act to disconnect the batteries in order to avoid damaging failures; (c) Controlling charge and discharge conditions; (d) Cell balancing; (e) Thermal management; (f) Estimation and communication of important battery parameters like SOC, SOH, SOL..

BMS shall incorporate Over/under voltage and over temperature protection and passive battery balancing Facility.

BMS shall assist precise remote monitoring of the battery state of charge, health and other operating conditions.

There shall be Facility available at battery to indicate the following:

a) Fully Charged: Indication when charging has been reduced or terminated due to a fully charged battery.

b) Battery Low: Indication when the battery level is low and energy conservation steps should be taken.

The indicators may be LED's, analog or digital meters, or audible alarm. The chosen device should come appropriately labeled.

Every Lithium Ion/ LFP battery shall be given a 10-year performance guarantee, along with lifetime technical support.

Charging efficiency should be as high as 90%.

The Battery module shall perform satisfactorily in humidity up to 100% with Temperature between – 10^{o}C to + 45^{o}C.

The proposed battery arrangement shall be provided by the bidder to demonstrate the equipment layout in the Powerhouse. Battery room shall be designed to minimize the possible risk of fire. It should be well ventilated and temperature shall be controlled to the value as recommended by the battery manufacturer. . Smoke detectors shall be placed inside the room. The battery room shall have two doors fixed at opposite directions. The proposed layout shall allow for sufficient space for maintenance staff.

All batteries shall be the same make, model, production year and size.

Battery wiring will be, at least, of 1000VDC insulation level

Every Unit will be numbered, and the most positive Unit and the most negative Unit in the string will be easily identifiable.

A full set of protective clothing will be supplied; eye protection, isolation gloves and any other equipment that deemed necessary to operate safely the battery.

Signs will be mounted above the battery set which clearly state the danger of high voltage shock, no smoking and the need to wear protective clothing. The signs shall also appear on the door(s) of the battery room.

The cycle life and durability of the batteries is a major issue in the project. The bidder will take into account the following points.

- The cycle vs DoD (Depth of Discharge) graph will be provided by the bidder.
- A minimum of 6000 cycles at 80% of DoD is mandatory.
- A calendar life of at least 15 years is required.

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Bidders shall furnish a Guarantee agreement for re-supplying, of batteries required for replacement or capacity increase of the battery bank when necessary in the future and installation of them and disposal of existing batteries. A model agreement is presented in Section 9 of the bid document. All bidders are requested to provide the duly filled and signed agreement with his offer. The future battery price is calculated based on the FOB price of the battery banks mentioned in schedules No.1 and Schedule no. 2 of price schedules given in Section 4 of the bid document for each hybrid system and by applying the Price variation formula given in the agreement. Supplier shall provide necessary indices and sources of indices required for the application of the price variation formula.

Regarding, freight, insurance and local transportation charges of the future supplying battery bank the supplier shall negotiate with IA and payment will be made on the prevailing market rates at the time of battery supply.

Battery bank replacement or installation labor cost shall be indicated in the agreement in terms of present monetary values and it will be considered as a fixed price.

Supplier shall confirm that all batteries must be removed from the project site and disposed under the responsibilities of the suppliers following requirements of Sri Lanka's waste management guidelines, policies and practices. The cost of transport and disposal shall be estimated and included for the battery disposal.

Transportation of Li-Ion/LFP batteries must follow these rules "UN dangerous good transport recommendations", model regulation ST/SG/AC10/Rev.16; UN 3480 category of dangerous goods: Class 9

4.3 Grid Forming Inverter

The Grid Forming Inverters shall be standalone type and each Grid Forming Inverter connected to battery storage. Each Grid Forming Inverter required shall convert DC power produced by battery banks in to purely sinusoidal AC power and the total Grid Forming Inverters shall be integrated together to form a three phase, 400V, 50Hz, distribution system. The continuous output power shall be selected to match with the capacity of the storage energy system allocated for each island.

4.3.1 Technical Specification for standalone grid:

(i) Control Type: Voltage source, microprocessor, PWM/MPPT, bi directional power flow.

(ii) Grid configuration: TT, 3 phase 4 wire system.

(iii) Topology: LF transformer

(iv) Frequency : 50 Hz (+5 Hz, -5 Hz)

(v) Rated power /Power for one minute Ratio: above 1.5

(vi) Maximum connectable power of Grid Forming Inverters: 2 *rated power

(vii) output voltage range : less than ±10% AC

(viii) Nominal Power : Depend on the project requirement

(ix) Power factor : 1 to -1

(x) Total Harmonic Distortion : less than 4%

4.3.2 General specification for inverter

(i) Housing cabinet : Grid Forming Inverter to be housed in suitable switch cabinet, Within IP 54 degree of ingress protection

(i) Efficiency :above 95 %

(ii) Operating temperature range : – 10^{o}C to + 60^{o}C

(iii) Power factor : 1 to -1

(iv) Noise emission : less than 50dB(A)

(v) Over voltage category in accordance with IEC 60664-1: III

(vi) Humidity : 0 to 100%

(vii) Environmental category: Indoor

(viii) Cooling concept: Convection

(ix) Climatic category according to IEC 30721-3-3: 3K6

4.3.3 Other important Features/Protections of Grid Forming Inverter:

a) Basic Protection of the Grid Forming Inverter

Short circuit protection

AC overload protection

DC reverse polarity protection

Over temperature protection

Battery deep discharge

AC overvoltage protection

EMI filter

Anti-islanding

Grid voltage variations

Frequency failures

Asymmetric currents

Voltage sag compensation

DC overvoltage protection

Inverter shutting down overload error

Batteries system isolation detector

b) Grid Forming Inverter shall be LCD and piezoelectric keypad operator interface and, Menu driven

c) At least two multifunction relays shall be available to be used in for load or source controlling actions

d) One connection shall be available for battery sensor

e) Communication interface for communication between clusters in a multi cluster system

f) 3 pole load shedding contactor with DC coil.

g) The Grid Forming Inverter shall be able to manage a standalone three phase grid based on L Li-Ion/LFP battery power, with additional decentralized AC coupled power sources like wind generators and PV plants and a central genset. The grid forming inverter shall be equipped with various management systems such as frequency, voltage maintaining of the system, synchronization of various AC sources such as diesel, PV and Wind sources, load scheduling between sources, switching on off diesel generators, protection against system fault, load management facilities etc. to guarantee the stable operation of the power system.

h) The Grid Forming Inverter shall identify the state of charge of batteries and shall start and stop generators accordingly. In addition it shall observe warm up and minimum running times as well as cool down periods of the diesel generator.

i) Battery charging shall take place through Grid Forming Inverter.

j) The inverter shall synchronize the frequency, voltage and phasing of the system established by the inverter with diesel generator. The inverter shall operate the diesel generator without overloading.

k) Grid Forming Inverters shall comply with the requirements defined in IEEE 1547 to ensure the stable standalone grid with voltage and frequency fluctuations within the acceptable limits.

l) The Grid Forming Inverter shall be compatible with the Li-Ion/LFP batteries used in the battery bank. The Grid Forming Inverter shall be capable of charging batteries in the range of its nominal power.

m) The capacity of the standalone grid shall be increased by increasing of additional battery banks, additional Grid Forming Inverters as well as further external energy sources.

n) The Grid Forming Inverter shall be equipped with programmable load control Facility including selected load shedding.

o) The parameters like power output, charging and discharging currents, threshold of battery voltage and times of operations shall be programmable.

p) The Grid Forming Inverters have to fulfill all requirements for an operation in tropical climates and sea water atmosphere.

q) The Grid Forming Inverter shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the Facility in which the Grid Forming Inverter is housed.

r) The Grid Forming Inverter shall have an appropriate display on the front panel to display the instantaneous AC power output and the DC voltage, current and power input. Each of these measurement displays shall have an accuracy of 1 percent of full scale or better. The display shall be visible from outside the Grid Forming Inverter enclosure. Operational status of the Grid Forming Inverter, alarms, trouble indicators and AC and DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front of the Grid Forming Inverter enclosure.

s) Grid Forming Inverter should support remote monitoring and controlling package provided under this project and compatible Communication protocols with networking Facilities shall be available.

t) The Grid Forming Inverter enclosure shall be weatherproof and capable of surviving climatic changes and should keep the Grid Forming Inverter intact under all conditions in the room where it will be housed. The Grid Forming Inverter shall be located indoor and should be either wall / pad mounted. Moisture condensation and entry of rodents and insects shall be prevented in the Grid Forming Inverter enclosure.

u) In the design and fabrication of the Grid Forming Inverter the site temperature (5° to 40°C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking and thermal for blocking diodes and similar components.

v) The manufacturer shall provide the 10 years warranty for the grid forming inverter.

w) Factory Testing:

(i) The Grid Forming Inverter shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected with parallel Grid Forming Inverters to form a three phase grid system, prior to its shipment

(ii) Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

(iii) Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

(iv) Operation of startup, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the Grid Forming Inverter and response to control signals shall also be tested and demonstrated.

(v) Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by the Purchaser.

(vi) A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted.

4.4 Other Accessories

Cable connections must be made using PVC insulated and PVC sheathed 600/1000V Cu cables of appropriate sizes as necessary and as per BS-6346 standards. All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in GL trays with covers for protection.

Fast acting semiconductor type current limiting fuses shall be used at the main busbar to protect from the grid short circuit contribution.

4.5 Manufacturing Experience

Manufacture shall have minimum of 10 year experience in Manufacturing Batteries, Grid Forming Inverters and Accessories. Further, the manufacturer shall have minimum of five (5) year experience in supplying Batteries, Grid Forming Inverters and Accessories to countries other than the country of manufacturer.

Manufacture shall provide proof document to prove his experience in accordance with above criteria.

4.6 Quality Assurance

The manufacturer shall posses ISO 9001:2008 or latest of Quality Assurance Certifications for the manufacture of Batteries, Grid Forming Inverters and Accessories for the plants where the manufacture of Batteries, Grid Forming Inverters and Accessories is done. Bidders shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

4.7 Test Certificates

The inverters should be tested and certified by a qualified institution and CE-certofied and in compliance with the applicable standards IEC 61000-6-2:2005; IEC 61000-6-4:2006; UL 1741 and IEEE 1547.

A copy of the certification shall be presented with the bid.

4.8 Inspection and Testing

The contractor shall make necessary arrangements for inspection of the equipment by two (2) Engineers nominated by IA and also to carry out necessary acceptance/sample tests in accordance with the relevant International Standards of following material and equipment offered.

a) Battery banks

b) Grid forming inverters

The contractor shall make necessary arrangements to observe the quality assurance system stablished in the factory of manufacturing as well as functioning of the facilities incorporated in batteries and inverters to fulfill requirements given in specifications.

The cost of inspection and testing shall be included in rates offered for Batteries, Grid Forming Inverters and Accessories.

4.9 Information to be submitted with the technical bid

Details with descriptive matter, catalogues indicating drawings, reference numbers and the literature of the items offered in accordance with the relevant cause of the specification including the following particulars shall be forwarded with the technical bid

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(a) Batteries:

- Curves and/or tables showing the Ah capacity for different rates of discharge (from C1 to C120)
- Battery type, voltages and Physical size and weight
- A statement of warranty
- Battery management system details.
- The environmental requirements needed within the battery location
- Certificate issued by an independent international organization to ensure compliance the ISO 9001:2008 standards by manufactures.
- Information to justify CE certification
- Duly filled A model agreement " Agreement for resupplying, installation and disposal of Li-Ion/LFP batteries is presented" in Section 9 of the bid document

(b) Grid forming inverter

- Inverter voltages, capacity, frequency, efficiency and other parameters
- Controlling and protection features incorporated in the grid forming inverter
- Details of enclosure and mounting information
- Type test certificates mentioned in Section 4.7 above.
- Certificate issued by an independent international organization to ensure compliance with the ISO 9001:2008 standards by manufactures
- Information to justify CE certification
- A statement of warranty

(c) Duly filled Table 2.3 of Guaranteed Technical Particulars given in Part D-Supplementary Information of the Bid Document

Chapter 5 – Wind Generator, Wind-Inverters and Accessories

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Chapter 5 – Wind Generator, Wind-Inverters and Accessories

5.1 General

The amount of wind power generation at each island measured at 400V busbar is presented in Clause 1 of Part A of Section 6 of the bidding document. The Contractor shall select equipment ratings according to the requirements given in Part A of Section 6 of the bid document.

The way of integrating the wind power generation with the Plants to be established is as following:

AC energy generated at wind generators panels are directed to rectifiers and converted to AC voltage. Then output of rectifier is given to the Wind-Inverter for converting in to three phase 400V, 50Hz, 4 wire, AC supply that is connected to the busbar at the Cluster Switch box. Wind power is integrated with 400V, 50Hz, AC, three phase 4 wire system formed by several clusters of batteries together with grid forming inverters. This connection is made at the Cluster Switch box. Cluster Switch box is a switching Facility to combine different energy sources i.e. solar, wind, battery and diesel generation together to provide the electricity demand of the distribution network.

Wind generators, Wind-Inverters and other main accessories used in hybrid energy systems are described here. All items shall have the characteristics as entered in the Technical Particulars & Guarantees in Employer's requirements.

5.2 Wind Generators

The individual capacity of wind generators to meet the total wind demand of each island can be decided at the design stage by considering the topology of the available land extent allocated for the installation of wind generators.

The generator shall be of maintenance free, three phase, and synchronous type and shall generate maximum output voltage of AC up to 400V. The turbine may have annual routine maintenance.

The generator shall be designed for tropical environment and in accordance with relevant international standards including IEC: 61400. The insulation class should be F or better.

The WTG shall fulfill the following main data:

a) Horizontal axis, 3-blade rotor, placed upwind of the tower.

b) Grid connected WTG with a rated power output 5 kW

c) Power control with either stall or pitch regulation.

d) Active yaw control, both clock-wise and counter clock-wise for over speed protection. Other alternatives will be considered.

e) Survival wind speed shall be higher than 50m/s (class I according to IEC 61400-2).

f) Operating temperature range shall be -20C to 50C (class I according to IEC 61400-2).

g) Cut in speed shall be below 4m/s.

h) Wind generator shall be three blade type. Blades shall be manufactured using Resin Transfer Molding (RTM) technology with fiber glass. Blades shall have special anti-sand coating.

i) The direct transmission is preferable.

j) Noise shall be measured according to IEC 61400-11 and the value shall be below 40dB (A) at a distance 60m with a wind speed of 8m/s.

k) The bidder shall supply a copy of type test report and routine test reports for each Generator.

l) The generators shall be housed in a waterproof enclosure to guarantee the water tightness. All metal parts shall be coated with marine grade powder coat for ensuring superior protection from the coastal environment. Paint used shall be UV resistant type to prevent aging and discoloration. Generators windings etc. must be special corrosion protected to cope with condensation problems caused by the high relative humidity/temperature gradient on the site.

m) Wind energy system shall have an electronic breaking system and hydraulic breaking system to prevent uncontrolled rotation.

n) Generator shall be protected against short circuit, earth fault, over load, over and under-voltage.

o) The WEGs shall have adequate protection and control to operate in parallel and Synchronized manner with the grid formed by battery and Grid Forming Inverter cluster system, The tolerance limits indicated may, however, be exceeded in actual conditions and the WEGs shall be protected from damages against such exceeding of limits.

p) The WEGs shall be designed to have a life of not less than 20 years for continuous peration. The manufacturer shall provide 5 years warranty.

q) Name of the manufacturer of wind turbine; month and year of manufacture; complete technical literature including Withstand capability for maximum 10 min average wind speed at hub height,· Withstand capability for maximum 2 sec. gust wind speed at hub height, certified power- speed curve and Annual energy- wind speed curve according to IEC 61400- 12 , noise level measurement according to IEC 61400-11; unique serial no & model no; Operational and maintenance manual, type and routine test reports, shall be provided by the contractor to Project Manager for approval. Technical particulars and general data of WEGs, Generator, Rotor, Tower, Yawing system, Brake system, Gear system (in case of geared machines), Hub, Nacelle, Main shaft, Main bearing, Coupling, Power panel, Control system, Power factor compensation (if required) warranty certificates shall be provided with the offer.

5.3 Wind Turbine Mounting Structure

Wind turbine mounting structures shall be decided considering limitations in sea transportation of heavy and long parts of the mounting structure from mainland to the island. The structures shall be designed for simple mechanical and electrical installation. There shall be no requirement of welding or

complex machinery at the installation site. If prior civil work or support platform is absolutely essential to install the structures, the supplier shall clearly and unambiguously communicate such requirements along with their specifications in the bid.

Steel tubular towers are preterred or the lattice tower option . The pole shall be assembled in three or four pieces. The pole shall be equipped with a hydraulic cylinder to erect the pole with an accompanying hand pump. Other alternatives are also considered.

Concrete foundations are preferred. Screw foundations shall be used. However, Contract has to provide screw type, galvanizing thickness and design details to Project Manager in advance. The foundations designs and calculations shall be done according to the soil testing reports. All design calculations shall be provided before the erection for the approval of the Project Manager.

Necessary foundation bolts/anchor plates/stubs/pre-fabricated basements should also be supplied. If screw foundations are used the screw driving machine shall be provided by the contractor. If tillable masts are used the hydraulic cylinder and hand pump shall be provided by the contractor. The exposed portion of the foundation bolts should be galvanized/ painted with anti-corrosive paint. Special attention should be paid on galvanizing of foundation screws used in wind mast foundations. The galvanizing thickness of foundation screws shall be sufficient to last them for 20 years period buried under salty soil conditions near the sea (at environmental category C4 as defined in ISO 9223). The pole shall be painted with marine grade powder coat for ensuring superior protection from the coastal environment.

The supplier shall specify installation details of the wind generator mounting structures with appropriate diagrams and drawings. Such details shall include, but not limited to, the following;

a) Design details with drawings of foundations;

b) Structure installation details and drawings;

c) Electrical grounding (earthing);

d) Machineries are to be used in construction stage

e) Galvanizing test reports

f) weight and volume of packing to arrange sea transportation from main land to the island

5.4 Rectifier, Wind-Inverter and Dump Load System

The rectifier required shall convert three phase AC power produced by wind generators into DC power. Rectified DC output is fed to Wind-Inverter where the voltage & frequency levels to suit the local grid conditions are formed. The Wind-Inverter shall feed singe or three phase 230/400V and 50Hz supply to the phases of the TT type three phase, 400V, 50Hz, AC distribution network established by battery clusters and/or diesel generator.

5.4.1 The technical Specification for controller

This comprises of a rectifier, a Wind-Inverter and a dump load as specified below.

(i) Control Type: Voltage source, microprocessor assisted, PWM, output regulation

(ii) Rated output voltage: single phase/three phase, 230/400 V ac

(iii) Grid configuration: TT, 3 phase 4 wire system

(iv) Topology: transformerless or with an isolation transformer

(v) Frequency : 50 Hz

(vi) Power control: Wind turbine MPPT power curve tracking algorithm at all wind speeds shall be provided to match the power curve of turbine.

(vii) Wind-Inverter /generator capacity Ratio: above 1.2

(viii) Wind-Inverter Input voltage range : to match with wind generator output

(ix) Nominal Power : Depend on the project requirement

(x) Total Harmonic Distortion : less than 4%

(xi) Inverter enclosure : Wind-Inverter to be housed in a suitable enclosure with IP 65 degree of ingress protection

(xii) Efficiency : 95% and above at full load

(xiii) Power factor : 0.95 inductive to 0.95 capacitive

(xiv) Operating temperature Range : 0 to 60 deg C

(xv) Over voltage category in accordance with IEC 60664-1: III for AC

(xvi) Maximum output fault current : 05kA

(xvii) Environmental category: Outdoor

(xviii) Noise level : <55dB (A)

(xix) Cooling concept: Convection

(xx) Climatic category according to IEC 30721-3-3: 4K4H

5.4.2 Other important Features/Protections of Wind-Inverter

- Mains (Grid) over-under voltage and frequency protection
- Automatic synchronizing

- Fool proof protection against Islanding.
- Protection against short circuit currents
- Protection against overheating
- All pole sensitive residual current monitoring device should be available for trasformerless Wind-Inverter
- LCD and piezoelectric keypad operator interface Menu driven
- Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.
- MOV type surge arresters of type III on AC terminals for over voltage protection from lightning-induced surges.
- All parameters should be accessible through an industrial standard communication link.
- Over load capacity should be 150% of continuous rating for 60 sec.

a) The controller-Wind-Inverter shall be self-commuted and shall utilize a circuit topology and components suitable for meeting the specifications listed above at high conversion efficiency and with high reliability.

b) The Wind-Inverter shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line-to-line fault currents and line-to ground fault currents. Wind-Inverters shall comply with the requirements defined in IEEE 1547.

c) The controller shall have a device for dumping excessive power generated if grid connection is lost, battery pack is fully charged or for emergency stop.

d) The Wind-Inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the wind turbine from damage in the event of Wind-Inverter component failure or from parameters beyond the Wind-Inverter's safe operating range due to internal or external causes. The self-protective features shall not allow Wind-Inverter to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the Wind-Inverter, including commutation failure, shall be cleared by the Wind-Inverter protective devices and not by the existing site utility grid service circuit breaker.

e) The Wind-Inverter shall go to the shutdown / standby mode with its contacts open under the following conditions before attempting and automatic restart after an appropriate time delay in insufficient wind power output.

(i) Utility-Grid Over or Under Voltage

The Wind-Inverter shall restart after an over or under voltage shutdown when the utility grid voltage has returned to within limits for a minimum of two minutes.

(ii) Utility-Grid Over or Under Frequency

The Wind-Inverter shall restart after an over or under frequency shutdown when the utility grid voltage has returned to the within limits for minimum of two minutes. The permissible level of under/over voltage and under/over grid frequency is to be specified by the bidder.

f) The Wind-Inverter generated harmonics measured at the point of connection to the utility services when operating at the rated power shall not exceed a total harmonic current distortion of 4%, a single frequency current distortion of 4% and single frequency voltage distortion of 1% when the first through the fiftieth integer harmonics of 30 Hz are considered.

g) The Wind-Inverter Power factor at the point of utility service connection shall be 0.95 lagging or leading when operating at above 25% of the rated output, but may be less than 0.95 lagging below 25% of the rated output.

h) The high voltage and power circuits of the Wind-Inverter shall be separated from the low-voltage and control circuits. The internal copper wiring of the Wind-Inverter shall have flame resistant insulation. Use of PVC is not acceptable. All conductors shall be made of standard copper.

i) The Wind-Inverter shall withstand a high voltage test of 2000 V rms, between either the input or the output terminals and the cabinet (chassis).

j) Full protection against accidental open circuit and reverse polarity at the input shall be provided.

k) The Wind-Inverter shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the Facility in which the Wind-Inverter is housed.

l) The Wind-Inverter shall have an appropriate display on the front panel to display the instantaneous AC power output ,current and power input. Each of these measurement displays shall have an accuracy of 1 percent of full scale or better. The display shall be visible from outside the Wind-Inverter enclosure. Operational status of the Wind-Inverter, alarms, trouble indicators and disconnect input/output switch positions shall also be communicated by appropriate messages or indicator lights on the front of the Wind-Inverter enclosure.

m) Wind-Inverter should support remote monitoring and controlling package provided under this project and compatible communication protocols with networking facilities shall be available.

n) Electrical safety, earthing and protection

(i) Internal Faults: In built protection for internal faults including excess temperature, commutation failure, overload and cooling fan failure (if fitted) is obligatory.

(ii) Galvanic Isolation: Galvanic Isolation is required of Wind-Inverter with transformer is selected.

(iii) Over Voltage Protection: Over Voltage Protection against atmospheric lightning discharge to the wind turbine and controller is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the Wind-Inverter, operational errors and switching transients.

(iv) Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on input side of the inverter and shall send message to the supervisory

system. The Wind-Inverter shall include an easily accessible emergency OFF button located at an appropriate position on the unit.

o) The Wind-Inverter enclosure shall be weatherproof and capable of surviving climatic changes and should keep the Wind-Inverter intact under all conditions in the room where it will be housed. The Wind-Inverter shall be located indoor and should be either wall / pad mounted. Moisture condensation and entry of rodents and insects shall be prevented in the Wind-Inverter enclosure.

p) In the design and fabrication of the Wind-Inverter, the site temperature (5° to 60°C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking and thermal for blocking diodes and similar components.

q) Factory Testing:

r) Maximum Power Point Tracker (MPPT)

(i) Maximum power point tracker shall be integrated in the Wind-Inverter to maximize energy drawn from the wind turbine. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be mentioned. The Wind-Inverter shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment

(ii) Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

(iii) Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

(iv) Operation of startup, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the Wind-Inverter and response to control signals shall also be tested and demonstrated.

(v) Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by the Purchaser. Tests may be performed at 25,30,75 and 100 percent of the rated nominal power.

(vi) A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted for constant voltage operation.

s) Disconnection and Islanding

Disconnection of the wind generator in the event of loss of the main grid supply is to be achieved by in built protection within the power conditioner. This may be achieved through rate of change of current, phase angle, unbalanced voltage or reactive load variants.

t) Operation outside the limits of power quality as described in the technical data sheet should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are: Neutral voltage displacement Over current Earth fault And reverse power. In case of the above, cases, tripping time should be less than (15 seconds. Response time in case of grid failure due to switch off or failure based shut down should be well within 5 seconds.

u) Wind-Inverter shall be compatible with grid forming inverters used in Plant.

v) 10 years warranty shall be provided for Wind-Inverters.

5.5 Other Accessories

There shall be an AC, 3P, manually operated breaker of appropriate rating. It shall be connected in parallel with wind generator output to provide Facilities for applying electric breaks.

There shall be an AC, 3P, MCB of appropriate rating before the Wind-Inverter input connection for isolation purposes.

AC surge protector of type II, 10kA and protection voltage of 1.5kV shall be fixed near the Wind-Inverter input terminal.

There shall be an AC, 2P, MCB of appropriate rating at place where the Wind-Inverter output is connected to the output busbar.

AC surge protector of type II, 10kA and protection voltage of 1.5kV shall be fixed near the Wind-Inverter AC output terminal.

Cable connections must be made using PVC insulated and PVC sheathed 600/1000V Cu cables of appropriate sizes, as per BS-6346 standards. All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in underground trenches and GL trays with covers for protection.

Fast acting semiconductor type current limiting fuses shall be used at the main busbar to protect from the grid short circuit contribution.

All metal supports and all concrete supports including tower, nacelle, Electrical equipment, controllers, Wind-Inverters, dummy loads must be earthed as per the IEE wiring regulations. The earth resistance shall be less than 1.0 Ohm in each of the earthing system. Before carrying out the earthing arrangement the bidder shall get the earthing design approved/certified from IA.

For each turbine all switches shall be installed in an enclosed panel in the power house. The switchboard must be incorporated all power distribution for the turbine and the cabin and their protection systems. Enclosure shall have enough space for future developments. Enclosure shall be equipped with space heaters with thermostats and incoming and outgoing cable glands. The

enclosure shall have a IP 44 degree of protection and shall be made for corrosion resistance material to match with coastal environment.

5.6 Manufacturing Experience

Manufacture shall have minimum of 10 year experience in Manufacturing Wind Generators, Wind Inverters and Accessories. Further, the manufacturer shall have minimum of five (5) year experience in supplying Wind Generators, Wind Inverters and Accessories to countries other than the country of manufacturer.

Manufacture shall provide proof document to prove his experience in accordance with above criteria.

5.7 Quality Assurance

The manufacturer shall possess ISO 9001:2008 or latest of Quality Assurance Certifications for the manufacture of Wind Generators, Wind Inverters and Accessories for the plants where the manufacture of Wind Generators, Wind Inverters and Accessories is done. Bidders shall furnish a certified copies of the ISO 9001:2008 certificate and CE certification document as true copy of the original by the manufacturer, along with the offer.

5.8 Test Certificates

The generator shall be type tested in accordance with relevant international standards including IEC: 61400.

The inverters should be tested and certified by a qualified institution in compliance with the applicable standards such as IEEE 1547.

A copy of the certification shall be presented.

5.9 Information to be submitted with the technical bid

Details with descriptive matter, catalogues indicating drawings, reference numbers and the literature of the items offered in accordance with the relevant cause of the specification including the following particulars shall be forwarded with the technical bid

.

(a) Wind generator:

- Power generation (kW) Vs wind speed graph of wind generators according to IEC 61400-12-1
- Estimated annual energy generation Vs wind speed graph of wind generators
- Wind generator construction material and construction details
- Wind generator control and protection features
- Physical size and weight
- Test certificates mentioned in Section 5.8 above.
- Certificate issued by an independent international organization to ensure compliance the ISO 9001:2008 standards by manufactures.

Statement of warranty

- Information to justify CE certification

(b) Wind generator Mounting structures
- Material details
- Weight, Dimensions and drawings;
- Structure transport and installation method;
- Foundation details

(c) Wind inverters
- Inverter voltages, capacity, frequency, MPP range
- Energy dumping technique in case of sudden disconnection from the grid
- Controlling and protection features
- Details of enclosure and mounting information
- Type test certificates mentioned in Section 5.8 above.
- Certificate issued by an independent international organization to ensure compliance the ISO 9001:2008 standards by manufactures
- Information to justify CE certification

Statement of Warranty

(d) Duly filled Table 2.4 of Guaranteed Technical Particulars given in Part D-Supplementary Information of the Bid Document

Chapter 6 – Control Switch Box and Grid Management System

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Chapter 6 – Control Switch Box and Grid Management System

6.1 General

The capacities of power generation sources at each island measured at 400V busbar are presented in Clause 1 of Part A of Section 6 of the bidding document. All generating sources in each system shall be integrated together to form an off grid hybrid energy system. The functions of the switching arrangement required for integrating different energy sources called a Control Switch Box and the Energy Management System are briefly described here as following:

AC energy generated at wind inverters, solar inverters, diesel generators and battery banks are integrated in a switching box and outgoing feeder busbar is also connected to it. The switchbox shall provide necessary switching and isolation facility for each circuit connected to it.

Grid Management System (GMS) consists of sensors, remote monitoring system for monitoring the weather related data, load demand information, system operating parameters and individual generating source parameters and a System Controller. System Controller shall automatically manage the hybrid system by preparing a daily generation plan, scheduling the available generation resources to optimize the unit generation cost and taking operational decisions at normal and emergency situations of the power system.

System functionality for the hybrid system

In this architecture, the grid forming task is switched between the genset and the grid forming inverter, allowing the minigrid to operate at times without running a diesel generator to save fuel achieving high energy renewable penetrations. In this configuration,

- The bi-directional grid forming inverter of the battery needs to function in all four quadrants (absorb/generate active/reactive power) and seamlessly transition between them. A droop-based approach in which the grid-forming inverter increases the minigrid frequency and the PV inverters detect it and curtail their output if necessary to maintain power balance. This method presents a clear advantage when the inverters are far apart from each other.
- The secondary control is usually programed in the grid-forming of the battery and it has the task of synchronizing and bringing online diesel generators following an algorithm that depends on the state of charge of the batteries and the current load. Some more advanced systems will have external algorithms for secondary control that factor load and renewable generation forecast to save fuel, optimizing the use of batteries.
- In the absence of renewable energy sources (Region 1, Figure 1), the Diesels gensets are responsible for forming the grid and serve the load
- When the renewable energy sources generation starts to pick up (Region 2, Figure 1), the genset began the process of ramping down the output power to maintain the demand load. At this stage load is shared by genset1 and renewable energy sources maintaining the grid stability. Depending on the renewable energy sources penetration level in each island, the PV excess can be used to charge the battery.

- If the available solar energy and the SOC of the battery allow it (Region 3, Figure 1) solar energy shall always be the prioritized energy to be used in the system, and diesel generators shall only be turned on if necessary.

- Whenever the RES output is low enough the load can be served (Region 4, Figure 1) by a combination of gensets, renewable energy sources and battery .

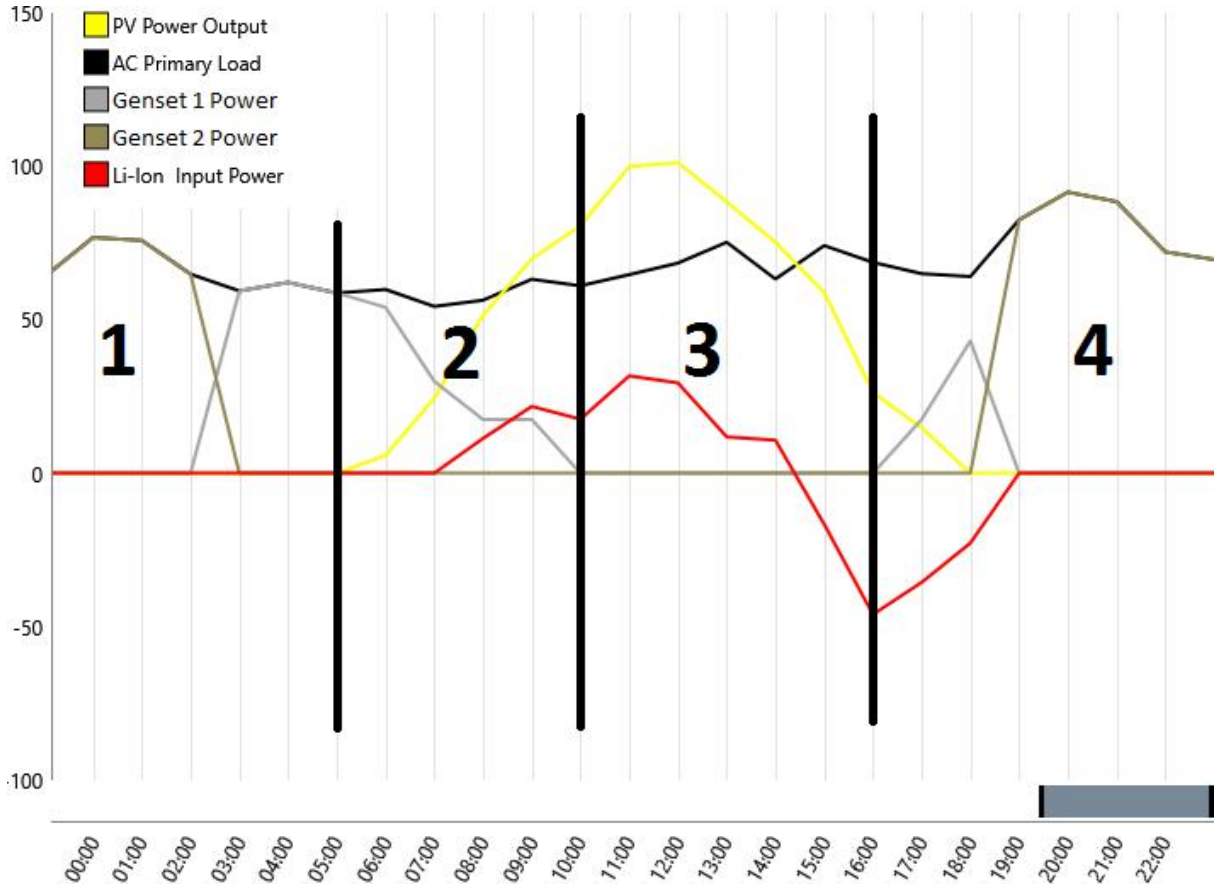

Figure 1: System Operation with different energy scenarios

- These detailed operations are closely conditioned by the statism curves implemented in the equipment control devices, so that determining these statism curves is considered a critical aspect for the correct operation of the grid.

Details of Control switch and Energy Management System are described here. All itGMS shall have the characteristics as entered in the Technical Particulars & Guarantees in Employer's requirements.

6.2 Control Switch Box

The box shall be completely wired and fitted in the factory.

The capacity of the switch box internal wiring, bus bars shall be capable of handing the energy generated in battery bank and each renewable generating source and additional 20% of total capacity shall be available for future increasing of all or any of the generating sources. Additionally, the switch box shall be compatible with inverters and diesel generators used in the Plant

The incoming and outgoing connections shall form an AC, 400V, 50Hz, three phase, 4 wire and TT system.

The equipment shall be equipped with wiring connections, isolators, breakers, fuses, relays and earthing equipment as necessary.

A set of contactors shall be available for load shedding purposes.

All communication cables shall be provided by the supplier.

The switching box shall incorporate active anti-islanding and reverse current monitoring facilities. An automatic bypass for the PV generators shall be available.

Rated AC insulation voltage of wiring shall be above 2kV.

6.3 Grid Management System (GMS)

Grid Management System consists of sensors, remote monitoring system a System Controller.

Remote monitoring and controlling system shall be provided with the latest software/hardware configuration and service connectivity for online / real time data monitoring/controlling and the operation and maintenance/control to be ensured by the supplier.

A GMS is needed to system monitoring, remote diagnosis, data storage and visualization of Plant information. The Monitoring System shall capture, store and transmit real time parameters of the solar power plants, wind power plants, diesel genset, battery system and ambient conditions for report generation and online analysis of plant performance by human or an automatic system controller in order to derive values for control parameters to ensure optimized Plant operation. Additionally, the GMS System should be able to generate remote site alarms and error reporting through email/sms.
Grid Management System shall be designed in such a way that the

(a) The complete Hybrid Plant can be remotely monitored and controlled from the Control Room located within the on-site Control Building. The Control room shall be provided the following computing facilities:

- A suitable Computer: 2.7 GHz Pentium with 80GB HDD, 1GB RAM, 2 Parallel & 2 Serial Port, Wi-Fi Lan Card, DVD RW Drive , 20" LCD, USB Scroll Mouse, along with 1 KVA ups .
- GSM/GPRS/ ADSL Modem/ Wireless Router + modem in case of Ethernet connection, must be provided for remote access.

(b) The collected operational information shall be retrieved by the user at any location by web portal software and mobile phone application software developed and provided by the supplier. This online cloud storage facility and the software applications shall be provided by the contractor.

The Plant parameters are collected by digital/analog signals captured from sensors mounted in the Plant at various locations. The GMS shall continuously collects all the data from the equipment on the Plant and inform of the status of the Plant at any given time. Additionally, there shall be facility in to transmit the data available in equipment/sensors to the central data collection center at the power plant through Ethernet/Bluetooth techniques. The collected data shall be transmitted from power plant to the web portal via 3G/4G modem. Inverters shall be interfaced to the device server via RS485/232/422/blue tooth techniques. All instruments and digital meters can interface to the device server via the standard serial interfaces e.g. RS232, RS422 or RS485 depending on the equipment's physical characteristics. Interfaces for serial data communication shall be enabled for utilizing international standardized data transmission protocols (e.g. IEC 60870-5-101, IEC 60870-5-104, IEC 60870-5-102, IEC 61850, etc.) to communicate. Others instrument can communicate to the remote I/O units via the 4-20 mA standard and Digital signaling.

Data logging system shall have to collect and store data required for controller action less than one minute period. The server shall have a backup capability to store data for 3 months period.

Real time controller software shall be provided that runs on the real time controller unit to collect all data from all sensors and all inverters. This software will make a decision to generate alarms when the data is lost or exceeds the limit bands. Industrial PC software shall be provided to run on the Windows

OS at the server at the power plant for storing a data back up and generating reports depending on the operator requirement. Also it shall retransmit the stored data to the supplier's web server. There shall be a real-time monitoring web server connected to a database server and accessed through an Internet portal. The supplier shall maintain a web service module and a web server module to serve the purchaser connecting via the internet to establish the connection and to check the control/Monitoring System information which includes real time chart, Historical, alarm and event logging and report generator. PC application and mobile phone application shall be provided to monitoring and enumerating of the collected data. To ensure availability, confidentiality and integrity of the GMS system each application program shall have two security levels other than the administrative level. The security level one is for monitoring purposes and security level -2 is for operational and maintenance staff. Additionally necessary cyber security measures shall be available.

The following parameters should be collected, stored and available for processing, reporting when necessary.

- PV array energy production: DC Voltage, DC Current & Energy generated by the PV system, operation status (On/off/curtailment/MPPT etc.) insulation resistance of the PV array shall be recorded.

- Wind energy production: AC Voltage, AC Current, Energy generated by the wind system, operation status (On/off/curtailment/MPPT etc.), operation time , shall be recorded.

- Diesel generator system: AC Voltage, AC Current on each phase, Energy generated (active and reactive), frequency, operation status (run/warming/cooling/fail etc.), operation time period, diesel consumption shall be recorded.

- Battery energy system: DC Voltage, DC Current, AC voltage of each phase Energy generated (active and reactive), frequency, operation status (charging/discharging/fail etc.), state of charge (SOC),battery health indices (temperature/emission level etc.) shall be recorded.

- The complete Plant: AC Voltage, AC Current on each phase, total demand (active and reactive), frequency, power factor, operation status (on/off etc.), shall be recorded. Additionally event recorder shall be available for recording low/over frequency, low/over voltage, earth fault and overcurrent events etc.

- Ambient condition: Solar Irradiance: An integrating Pyranometer (Class II or better) shall be provided, with the sensor mounted in the plane of the array. Temperature: Temperature probes for recording the Solar panel temperature and ambient temperature shall be provided. Wind speed, ambient temperature, rain data with direction and humidity etc. shall be recorded from the fixed weather station.

All equipment used shall be plug and play type. The Monitoring System shall have facilities to expand for future equipment additions by incorporating additional modules. The selected communication and data exchange protocols shall assist the interoperability of devices.

The controller shall be capable of doing the following functions.

- use past and present load demand, ambient conditions, battery and inverter limitations to forecast hourly/daily demand

- preparing daily/hourly cost optimum generation plan.
- Real time scheduling operating set points for controlling voltage, frequency of the system
- Taking real time operational decisions at normal (synchronization of energy sources, battery charging etc.) and emergency system conditions (sudden load or generation variation, system fault) to guarantee secure, reliable, and high quality power supply.
- Shall be able to communicate with all connected equipment to monitor and control individual equipment functions when required.
- Display all just in time data to be displayed by 55" LED screen and to be able to show past data as required.

The supplier shall provide 5 years warranty for all equipment supplied.

The supplier shall provide a comprehended description of Grid Management System providing schematic drawing of the proposed Monitoring System, sensor details, connecting protocols, Controller functions, communication equipment with maximum possible distances, program operating guide, operating and maintenance manuals, recommended wire types etc.

6.4 Manufacturing Experience

Manufacture shall provide proof document to prove his experience in accordance with above criteria.

6.5 Quality Assurance

The manufacturer shall possess ISO 9001:2008 or latest of Quality Assurance Certifications for the manufacture of Control Switch Boxes or panel boards.

The manufacturer shall possess ISO 9001:2008 or latest of Quality Assurance Certifications for the supply, development, operation and maintenance of computer software and related support services.

Bidders shall furnish a certified copy of the ISO certificate with the offer.

6.6 Training

The contractor shall arrange a training session for 20 persons at the place closer to the site for operational and controlling features of the Grid Management System. The cost is deemed to be included in the rate for providing GMS.

6.7 Information to be submitted with the technical bid

Details with descriptive matter, catalogues indicating drawings, reference numbers and the literature of the items offered in accordance with the relevant cause of the specification including the following particulars shall be forwarded with the technical bid

.

(a) Control Switch box

- Construction details and dimensions
- layout drawing
- Switching and controlling facilities incorporated
- Statement of warranty

(b) Grid Management System

- Controlling and operational features
- Details of sensors, meters and other accessories used
- Statement of warranty

(c) Duly filled Table 2.5 and Table 2.6 of Guaranteed Technical Particulars given in Part D-Supplementary Information of the Bid Document

Chapter 7 – Civil Works

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Chapter 7 – Civil Works

7.1 General

This section covers the Preliminary investigation, Design, Construction and supply requirements for all civil and associated mechanical and installation works of the proposed Plants in three Islands.

The specification is describing quality standards, required functions and certain philosophies for the turn key civil contract, but is in no case a detailed specification. Therefore the requirements are not limited to the descriptions hereafter; items not mentioned shall be in the same best quality range as for the entire works of the project.

The civil Employing design of the Contractor will take into account all relevant data and requirements of the equipment to be installed, necessary for a long service life and faultless operation of the Plant. This concerns primarily safety, durability, cost effectiveness and aesthetic criteria, and provided that the requirements of functionality and compatibility are respected and clearly understood.

The civil works referred in this document must be performed in such a manner that the high standards of quality and function required in detail below are fully achieved,

The buildings and parts of the Plant must form an architectural, structural and functional unit. Special attention must be paid, in addition of basic design and construction, to the aspects which are specific to climate, soil condition and sea level variations, and local requirements.

The buildings and structures shall be designed with due regard to the need for inspection, maintenance, cleaning and repair, and able to operate on long-time periods with the minimum of inspection, adjustment and repair.

All material shall be new and of the best quality suitable for working under the conditions, variations in temperature and load encountered in service without undue distortion or deterioration or the occurrence of undue stresses in any part, such as to affect the efficiency and reliability of the substation.

The materials and construction methods will be selected on the basis of relevant experience in a similar environment.

Additionally, all static dynamic loads as well as all local environmental, impacts and characteristics (Specially the surface and ground water conditions) will be taken into consideration in the structural calculations and design of the buildings and outdoor structures.

Special consideration will be given to the fact that the works are to be carried out in restricted space and no interruption of or disturbance to the transport Facilities and functionality of the neighboring utilities and services should occur during the execution phase of the works.

The Contractor is not allowed to use the works, materials or furniture or parts thereof for temporary purposes without the written consent of the Employer.

The General Conditions and Tender Drawings shall be observed in conjunction with this Civil Part of the Tender Documents specified here below.

The bidders have to make site visits to satisfy themselves that information given in the Bid Document is accurate and satisfactory and to collect any additional data and information required for preparation of their tenders.

He also shall satisfy himself as to the availability of all labour, plant, materials and other items necessary for the satisfactory execution of the works. The contractor shall implement the soil investigation for Civil and structural designs. This tender shall include costs for all unexpected eventualities.

7.2 Contractors Responsibilities

This contract includes all civil works and services, associated installation works. The offer must cover all requirements stipulated in the Bid Documents and any other items not specifically mentioned but which are deemed to be necessary for the satisfaction of the Employer. No additional costs will be considered for any works which have not been expressly specified but which are essential and necessary for the proper completion of the project in every respect.

The offer must include outline drawings and information to indicate the main proposals, concepts and materials being offered by the bidder.

The successful bidder later here mentioned as Contractor will be responsible for the performance of all civil and associated mechanical and installations works, including but not limited to the design and execution of works, as well as for the direction, coordination, supervision, testing and general progress of works according to the key dates fixed within the Contract.

The Bidder shall submit with his offer an outline civil program based on the overall time schedule showing how the works are scheduled to be completed in the contractual time available.

After the award of the contract, the contractor shall carry out detailed soil tests at required locations in the site and the foundation designs should be based on the test parameters. A soil testing report of each land that is selected for the construction of a power plant building in each Plant is given in Annex C10 for your reference. Please note that it is only for getting an initial understanding of the prevailing soil conditions at the site. However, the contractor shall carry out one or several types of soil tests at one or few locations decided by the Employer to get necessary soil parameters for design of the foundations such as foundations for power plant building, for wind generator masts etc.

7.2.1 Preliminary

The contractor should provide temporary Stores for building materials with necessary Facilities such as loading/ unloading equipment, electricity and water supply.

Work implementation schedule

Within 14 days after awarding the contract, the Contractor has to prepare and submit to the Employer a detailed schedule for all civil works developed from the contents of the above schedule. In addition to the individual program, he has to prepare a key program on a single line basis showing the phasing of the works as a whole and the critical key dates of the works.

The program shall be discussed and adjusted with the Employer/Employer. Once the program has been agreed it cannot be changed without the written approval of the Employer/Employer.

7.2.2 Design of the works

Design and drawings

The Contractor shall design the civil and associated mechanical and installation works and prepare complete working and workshop drawings as necessary for construction.

The Contractor shall be required to produce full design calculations for foundations, building structures etc. and detailed working drawings, bending schedules etc. He shall be responsible for the detailed design, strength and safety of the structures, to meet the structural, acoustic and environmental requirements of the buildings and other works. He will be responsible for ensuring that the design satisfies the requirements of all authorized local and national bodies. Design calculations and detailed drawings must be submitted to the Employer for approval before the relevant construction work shall be carried out and at least four weeks before the relevant drawings are required on the site for execution.

The top surface of the soil may be sandy. Limestone may found at a depth of 2 to 6ft depth variation which will extend up to certain depth. Bearing capacity of the soil for each island may be as stated in soil test reports attached, which shall be confirmed with a comprehensive soil test at execution stage. But the value should be clarified with a suitable bearing capacity test. And the value obtain from the

test can be used to design the foundations. Soil testing reports for lands selected for power plant building at each island is attached as Annex C10 for information and which will provide an idea about the soil layers in the area. However, the contractor shall carryout soil testing at required locations to get actual parameters.

7.3 Scope of Supply and Services

This section sets out the scope of the civil works to be included in the tender documents for construction of the Plants at Analithivu, Nayanathivu and Delfts.

7.3.1 General

Soil investigation Included in the scope of works are; Construction of wind turbine foundations, erection of wind turbine supports, mounting structure for the PV panels, structures and foundations necessary for mounting of the Generator and battery bank, including peripheral security fencing around the allocated land area and PV mounting pergola associated mechanical and installation works, and any other measures and activities needed for safe and efficient operation:

(a) and any other investigations require for the design and construction of the project

(b) structural, civil and architectural Employering design of buildings, structures, foundations with full static analysis, design, execution and submit as built drawings

(c) According to the soil investigation report study, design and execution of civil works (drainage system, prevention of flooding and tiding possibility of the sites, safety measures, etc.)

(d) Site organization for the entire project execution phase, including but not limited to:

(e) Filling - leveling of all temporary and permanent surfaces allocated for the works

(f) Temporary buildings for offices, stores, workshops, sanitary Facilities, first aid station, etc. and office for the staff of the Employer

(g) Security installations on site, including temporary fencing, etc.

(h) Access roads and outdoor storage Facilities

(i) Buildings shall include power plant building, labour quarters, supervisory staff quarters and security office at the entrance as attached drawings in Annex C2 and Annex C3.

(j) water and electricity supply - sewage system etc.

(k) Final cleaning of the temporary and permanent sites to the full satisfaction of the Employer.

(l) Housekeeping and cleaning of the sites during construction equipment erection/testing works

(m) Preparation of sites, including also the surfaces allocated for temporary activities of the site organization

(n) a key task of the Contractor will be the drainage and dewatering system of the site, including water channels and executed to the full satisfaction of the authorities and Employer.

(o) Removal of all vegetation, debris, underground obstacles (if any) and surplus materials to approved dumping locations

(p) Earthworks, temporary and permanent drainage works, refilling works on the plant site and on the additional areas allocated for temporary works

(q) All ancillary works and installations necessary for the execution of civil work, such as but not limited to: dewatering, fencing, signs, scaffolding, etc.

(r) Fabrication and fixing of name board in accordance with Annex C8.

(s) Execution of complete buildings, foundations and structures as needed for installation of the Diesel generators, battery bank and Plant, PV arrays and inverters, wind inverters and with an additional 25% space availability for future developments.

(t) execution of all finishing and indoor installation works (such as doors, wide roller doors, windows, wall cladding and rooting) painting and coating works, sanitary works, plumbing, heating-ventilation-and air conditioning works, sewage, electrical lighting, lightning protection, grounding, ramping, loading bays etc.

(u) Construction of wind support foundations. Wind support foundations shall be screw anchors or concrete foundations. If screw anchor foundation is selected, design calculations for each wind foundation shall be provided for the approval. For places in which, the anchor foundations cannot be installed, a concrete footing may apply as alternative. Concrete foundation shall be designed using British standard or equivalent or superior.

(v) erection of wind masts and mechanical and electrical installation of wind plants

(w) Mounting PV panels on the top of the roof of the power plant building and design and construction of a pergola to accommodate the balance PV panels on its roof.

(x) Execution of all necessary outdoor works for water supply, sewage and drainage works, fire-fighting, grounding, landscaping etc.

(y) Construction of cable trenches from wind generators to the power plant building and within the power plant building

(z) perimeter walls and/or fencing as well as gates

(aa) Security hut small size

7.3.2 Limits of supply

The scope of this specification covers all supply and services related with civil work and required for meeting the purpose of the Plant, even this is not expressly mentioned in this document.

The contract terminal points and interfaces are listed here below.

However, it is proposed that the Bidders should visit the sites in order to establish together with the Employer the precise location of power plant building and wind turbines.

Any civil construction which are not specified / included in the specification, but required for safe reliable operation of the Plant shall be deemed to be included in the scope of works and the Contractor shall carry out such works at no extra cost to the Employer.

(a) Roads and pavings: boundary fencing including access connections to the existing public roads.

(b) Storm water: at a convenient existing drain, or discharge in a controlled way to the surrounding areas, in agreement with the requirements of the authorities.

(c) Sewage system: discharge in a controlled way in adequate designed and dimensioned soak pits.

(d) Cable and pipe ducts: as described in the electrical works.

(e) Potable water: The plant water supply shall be ensured by underground water from a well and an overhead storage tank of minimum capacity of 5000 Liters, a water pump and piping for plant cleaning, showers, sanitary and other requirements.

7.3.3 Hybrid Energy System (Plant)

The lay out drawings of Plants in islands are shown in Annex C4.

The arrangement comprises one control building, a gate, foundation for required numbers of Diesel generators, the surrounding boundary fence, an outdoor pergola attached to the power plant building, foundations for required nos. of wind turbine supporters, cable trenches, internal roads and sewage system, Supervisory staff quarters, labour staff quarters and Security office.

The arrangement of the floors and sections of the proposed power plant building, supervisory staff building, labour staff building and security office are shown in Annex C2 and Annex C3. The contractor is allowed to change the dimensions of the power plant building Facilities depending on the requirement.

7.4 Design Criteria for Civil Works

7.4.1 Standards and codes of practice

Civil Employering works and services shall be designed and constructed in accordance with British Standards and/or Sri Lanka Standards and Codes of Practices.

The Standards and/or Codes of Practice employed throughout the works should in no case conflict with the local by-laws.

Following standards and codes of practices shall be used as basic standards.

BS 8110-1-1997	Code of practice for Design & construction
BS 8110-2-1985	- do - for special circumstances
BS 8110-3-1985	Design chart for reinforced Beams (Singly & Double) and column
BS.4449- 1997	Spec. for carbon steel Bars for R/F Concrete
BS.6399	Loading for Building
BS.6399 -	Part 1 - 1984 C.P. for dead and imposed load
BS.6399 -	Part 2 - 1995 C.P. for wind loads
BS.6399 -	Part 3 - 1988 C.P. imposed roof loads
BS.8004- 1986	Foundation Code of practice
B.S.5328-	Part l - 1997} Concrete specifying
B.S.5328-	Part 2 - 1997}
B.S.5328-	Part 3 - 1997}
BS 1377	Methods of Test for Soils for Civil Employering
BS 5628	Code of Practice for Use of Masonry
BS 5720	Code of Practice for Mechanical Ventilation and air conditioning in buildings
BS 5930	Code of Practice for Site Investigation
BS 5950	Structural use of steelwork in buildings
BS 6465:Part1.1994	Sanitary Installation

BS 6700:1997	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages
BS 7671:2001	Requirements for electrical installations, IEE wiring Regulations, Sixteenth edition
BS 8301:1985	Code of practice for building drainage
BS 8888	Employering Drawing and Technical Product Specifications

CP 3 Chapter V part II basic data for design of buildings

As far as practicable, the standards or codes adopted shall be consistent throughout all sections of the works except when they meet superior specified requirements.

The Contractor shall investigate the existence of any regulations and local by-laws governing the proposed works in Sri Lanka which are valid max. 30 days prior to the date of tender submission and he shall be deemed to fully comply with such requirements.

7.4.2 Design loads

The following design loads shall be considered for the design of buildings and structures:

Dead load

Dead load is defined as the weight of all permanent structures, including walls, foundations, floors, ceilings, partitions, stairways and fixed service equipment. This includes internals, pipes and accessories, electrical and lighting conduits, switchgear transformers, instrumentation, fireproofing, insulation, ladders, platforms and other similar items.

Erection dead load

The erection dead load is the weight of the equipment at the time of erection plus-the weight of the foundation. The foundation weight is the combined weight of the footing, pedestal and overburden soil.

Live load

Live load is defined as the weight superimposed by the use and occupancy of the building or other structure, but not permanently attached to it. For design, live load can be defined as the load produced by personnel, moveable equipment, tools and other items placed on the structure, but not permanently attached to it.

Recommendations for live loads (in kN/ m^2)	Slabs and subsidiary Supports
1.1 at road level in areas used by large vehicles	15
1.2 Inverter/Battery room and Control Room	7
1.3 Generator room	7.5
1.4 Toilet Mess Room floor slabs	2.5

Thermal load

Thermal loads shall be defined as forces caused by changes in temperature due to the expansion or contraction of the entire structure or individual structural components.

Impact load

Any live load that can produce a dynamic effect (such as a moving load) shall be increased by an impact factor.

Truck load

Structures accessible to trucks shall be designed to withstand the gravity, lateral and impact effects of truck loading. Truck loading shall be SLW 60 as defined by DIN 1072 or equivalent, but should the vehicles actually expected result in more severe loading conditions, these shall apply.

Soil load

Soil loads shall consist of lateral earth pressures. Active and passive coefficients for lateral pressures shall be obtained from the project soils report. The weight of soil shall be considered as dead load.

Hydrostatic load and buoyancy

Hydrostatic load is the load due to water pressure. The design of structures shall include hydrostatic loads. The buoyancy load is equal to the weight of the volume of displaced water.

Wind load

All wind calculations shall be made in accordance with the specific local standards.

Earthquake load

The local earthquake standards and rules have to be observed.

7.4.3 Fire criteria

To provide resistance to the collapse of the structure in the event of a fire, all structural elements of the building shall have the following minimum fire resistance:

Single storied structures:	
External walls and columns	1 hr
internal walls and columns	1 hr
Roof Non-combustible	
Two storied building:	
External walls and columns	2 hr
Internal walls and columns	2 hr
Roof	Non-combustible

Doors and windows shall have a minimum fire resistance of an hour.

Steel ladders

Rung: prefabricated safety-steps

Rise: 300 mm

Width: 500 mm

Safety cages shall be provided if height exceeds 3.0 m.

Handrails

Handrails shall be min. 1100 mm high.

Gratings

Gratings shall be hot-dip galvanized.

Checker plates

Checker plates: Galvanized mild steel with min. thickness over the plain portion of 8mm

7.4.4 Drainage systems

General

The drainage systems will consist of underground piping, open ditches and combination of them. In general, drainage systems shall be designed in accordance with BS 8301, BS 6031 or equivalent.

The drainage shall be separated into the following systems:

(a) storm water and surface drain,

(b) Sanitary sewage,

(c) Oily water.

7.4.5 Road works

Design basis

Design of the roads shall be based on the following minimum requirements:

(a) All roads to be single carriage way, minimum 6 m wide, if the configuration of the site allows this criterion.

(b) Sub base shall be well graded natural sands, gravel or rock or mixtures thereof shall be laid in accordance with standards to give a finished thickness of at least 200mm or as approved by the Employer.

(c) Wearing surface shall be of grade C20 (1:2:4 . 20mm) concrete having the thickness of 150mm. 10mm diameter tor steel reinforcement shall be used at 300mm interval in both ways. The dimensions of each road slab shall be 3mx3m.

3.4.6 Site leveling earth works setting out and tolerances

The Contractor shall submit this proposed finished site levels, road levels and building floor levels for the approval of the Employer. The site filling and leveling works shall be determined by the Contractor considering the following criteria:

(a) Optimization of the costs

(b) Safety against over flooding of the site

(c) Safety against pressure of water for the underground parts of buildings

The Contractor shall be responsible for all setting-out, irrespective of any checking by the Employer.

The Contractor shall inform the Employer within 24 hours whenever a new setting-out peg is established or an existing one destroyed, and shall regularly furnish the Employer with layout plans showing all current setting-out and survey stations.

The Contractor shall keep duplicate copies of all his field books and survey calculations written in the English language for inspection by the Employer.

The tolerances shall be in accordance with BS 5606 and BS 5964. The Employer may at his discretion alter or specify new tolerances as necessary.

3.4.7 Cable ducts and trenches

The Contractor is responsible for all civil works required for the cable runs between the outdoor installed equipment and buildings, in concrete cable trenches. Main cable trenches shall be rack types with sufficient working space. Cable entries into buildings shall be through ducts or in concrete cable trenches. Trench outside buildings shall be of reinforced concrete, designed for the maximum likely imposed loads appropriate to their location. Concrete cable trenches shall be adequately sloped and drained to soak ways of adequate capacity. All cables must be laid on cable trays with sufficient height above the base for easy drainage of storm water.

Power cables shall be laid on and surrounded with sand fill in unlined trenches. Pre-cast concrete cable protection covers & PVC marker tapes shall be provided over the full width and length of cables in sand filled trenches. Pre-cast concrete marker posts shall be provided along cable runs at 5 meters centers and changes in direction.

Power cable which passes under roads, vehicle parking areas, hard standing areas or where they would otherwise be at risk shall be laid in ducts. A 100% additional capacity shall be installed for future use and the whole surrounded in a minimum of 150 mm thick C10 concrete. Conduits provided shall be sized to suite the cables provided. All other main cable trenches shall have additional capacity of 30% for future use.

Cable entries into buildings and equipment shall be made watertight sealed to prevent the entry of any water, dust, vermin, etc. using suitable materials at entry points.

7.4.8 Perimeter security fencing

The perimeter of the site is to be fenced with PVC coated chain link fencing (see Annex C5), attached to concrete supporting posts. The posts shall have three strands of PVC coated barbed wire attached to cranked tops. Double leaf gates shall be provided at the entrance to the site (see Annex C6). All steel sections including gates, checker plates, ladders, hand rails, bolts, nuts and washers, shall be galvanized at the manufacturer's premises by means of hot-dipping in accordance with internationally recognized standards such as ISO 1459 or equivalent approved by the Employer. The minimum thickness of galvanizing shall be 145 microns.

7.4.9 Power Plant Building

The power plant building shall consist of a reinforced concrete structure and insulated roof, cable cellar with concrete floor with hollow concrete block walls, plastered rough finish outside and smooth finished plastered inside and tiled floor except for the generator room. Generator room and outside pavement should be cement floated.

The floor level of the building shall be fixed by the Contractor in accordance with the situation of ground water level, subject to the approval of Employer for each site.

All rooms where equipment is installed shall be provided with fire resistant ceiling to withstand pressure and temperature produced by gas leakages, fire of cables etc.

The following rooms shall be accommodated in this building:

(a) Control room

(b) Battery and inverter room

(c) Generator room

(d) Toilet

(e) Mess room

(f) Mechanical ventilation: in all rooms except where air conditioning is provided (i.e. toilet, mess rooms, wind and solar inverter rooms.).

(g) Air conditioning: control and battery inverter room shall be air conditioned. The capacity of the air conditioning unit shall be selected by considering the requirements of Li ion batteries. Two air conditioning units of equal ratings shall be installed in battery room and one unit alone is sufficient to provide the retired service while the other unit is out of service.

Doors and windows

All external doors and internal doors of building shall have aluminum doors and windows.

Floors

Control room shall have Tile floor. Toilets shall be provided with non-slippery ceramic tiles. The battery room shall be provided with acid resistance ceramic tiles.

The buildings shall be designed with ease of operation and maintenance as a major factor. Materials, workmanship and finishes shall be of an appropriately high standard.

Particular attention shall be paid when designing the buildings to fire prevention and safety of the personnel at all times. Escape doors shall be provided.

The Contractor will be responsible for the provision and installation of a water supply serving the substation buildings.

The town water supply should be connected to a 2.0 cubic-meter header tank in an elevated location at least 4m height above ground level to have a better pressure in the water supply system. A well of having a minimum diameter of 1.5m shall be constructed up to the depth agreed by the Employer and Contractor, if island water supply Facility is not available

7.4.10 Lightning protection

A complete lightning protection system for the building shall be constructed in compliance with BS 6651.

An air termination network shall be installed on the surface of the roofs. Salient points of the structure such as air conditioning installations, vent pipe railings, gutters, and steel constructions etc. shall be connected to the network.

Down conductors shall be distributed around the outside walls of the building with a maximum distance of 20 m and all main metal parts near the down conductors shall be connected there to. Each down conductor shall be provided with test joints in such positions that periodic testing is easily possible.

All connections and joints shall be installed mechanically and electrically effectives (clamped,

Screwed or welded) to suit the local climatic conditions.

For every building, at least one ring of ground conductors shall be installed and interconnected.

Materials:

Air terminations: Tinned copper 8 mm diameter

Earth terminations: Copper 8 mm diameter with lead coating minimum 1.2 mm thick as protection against corrosion

Ground rods: Tinned copper weld or stainless steel 3000 x 30 mm diameter

Potential equalizing bars: tinned copper 500 x 50 x 5 mm

All supports and connections shall be made of best suitable materials.

7.4.11 Foundations for Generator

In generator foundations provision shall be made for the catchment of oil spillage from the generator resulting from mechanical or electrical failure. Oil separators shall be provided to prevent pollution of streams, ground water, irrigation ditches and other watercourses by leaking or ejected oil.

Each generator shall be provided necessary air inlet, outlet Facility and ventilation space recommended by the generator manufacturer.

The foundations supporting the generator shall incorporate built-in haulage bollards, rails, slipways, etc., for the purpose of transport, unloading and locating the generator in their required positions. The generator room foundation should be designed to accommodate one additional same type of generator in future.

7.4.12 Foundations for wind turbine masts

The supplier of the wind turbine shall provide an screw anchor foundation design including calculation details to the Employer for approval. The anchor size and galvanizing thickness of foundation anchor and washers shall be matched to operate the system successfully for 3o year's life time. The necessary anchor driving equipment shall be provided and can be operated with 230V,50Hz supply.

7.5 Technical Requirements for Execution of Civil Works.

7.5.1 Site survey

The Contractor shall survey the site to establish the following:

(a) location of datum for setting out and leveling

(b) Site boundaries and reduced site datum level

(c) The complete drainage pattern of the area.

The Contractor shall survey the sites of the substations to a scale of 1:500, showing the survey results and proposed layouts of the substations.

7.5.2 Sub-soil investigations

Soil investigations have to be implemented by the contractor, which has to be used for foundation designs.

7.5.3 Site clearance, and earthworks

7.5.3.1 Site clearance

The Contractor shall clear all areas required for the work. All unwanted materials, debris, etc. shall be removed from the employer's premises. The contractor shall take all reasonable precautions to prevent damage to existing road construction and to existing surfaces, buildings and other Facilities in the area which do not need to be demolished.

Bushes, undergrowth, trees and hedges which are not specifically noted on the drawings or in the contract for preservation shall be uprooted and burnt or otherwise disposed of. Holes left by uprooting shall be promptly filled with suitable material and compacted.

7.5.3.2 Earth works

Excavation

The whole of the excavations shall be carried out to the widths, lengths and depths shown on the approved drawings and in accordance with BS CP-8004 and, BS6031..

The Contractor may excavate by any method considered suitable, subject to the Employer's approval, and shall allow for the use of types of plant most suited for excavation in any location and at any time.

The Contractor is to provide all strutting and shoring necessary for the safe execution of the Works.

The Contractor shall allow for risk of meeting and having to excavate through any sort of soil, which may be encountered, including rock.

Materials from the excavation may, if approved by the Employer, be used by the Contractor in the construction Works. Other excavated material shall be back filled where required or deposited where directed anywhere on site. Surplus materials shall be removed from the site by the Contractor.

The Contractor shall at all times keep the site free from all surplus materials, rubbish and offensive matter.

In foundation bottom 150mm layer of excavation in thickness shall be left undisturbed and subsequently removed only when the concrete is about to be placed in order that softening or deterioration of the surfaces of the bottom of the excavated area by exposure may be avoided as far as possible.

The bottom of all excavated areas shall be trimmed, leveled and well rammed. Concrete shall not be deposited thereon until the bottom has been inspected and approved by the Employer.

De-watering

All excavation works are to be kept dry and clean, in order that work is not affected or interfered with by water entering the excavations. The Bidder is to allow in his Tender for the costs of pumping, de-watering or other methods of dealing with the water during and after excavation.

Arrangements made for dealing with water in excavations shall be approved by the Employer. They must ensure that the de-watering of excavations can continue during the placing of concrete or the execution of any other works, which could be affected by water in excavations. Adequate precautions must be taken against washing out of cement and concrete or to prevent the work being disturbed in any way.

Water from pumping or other dewatering methods shall be properly drained away from the site or disposed of by tankers, so as not to inconvenience users of adjacent properties or sites.

No concrete, masonry, brickwork or other materials shall be placed or built until the surfaces are properly drained.

Filling and reinstatement

Filling for trenches, excavations and leveling of the site shall be deposited in layers not exceeding 250 mm uncompact thickness, each layer watered when necessary and well rammed or otherwise compacted to within 95% of the maximum dry density obtained by the use of a Proctor Standard Compaction Test.

Imported filling shall consist of pervious naturally occurring material, free from mud, silt, clay, peat, vegetable or injurious matter and water soluble salts harmful to copper and other metals. Filling shall be imported only from approved areas.

Please note that the environmental laws prevailing in the islands do not allow anyone to use sand or soil for construction activities and all required material shall be imported from the mainland.

Stability of fill and embankment

The Contractor shall be responsible for the stability of embankments, which formed either by cutting or filling, and precautions taken to protect the earthworks from deterioration under adverse weather

conditions. Wherever applicable the recommendations contained in the following codes of practice shall be followed in calculations, detailing and performance of the earthworks and drainage.

Earthworks - British Standard Code of Practice BS 6031-1981

Embankments shall not be formed over inclined ground surfaces without previously forming the founding surface, on which the Hill material will be placed, to a benched profile.

All top surfaces of earthwork shall be finished off level and regular and the sides of cuttings and embankments shall be properly trimmed to the detailed slopes. The soil stability of such slops etc. shall be ensured.

The Contractor is to allow for embankments and cutting slopes to be well forked, raked and stabilized as protection from erosion to the approval of the Employer.

The Contractor shall construct where necessary open ditches, bunds, culverts, etc., to divert and protect the site in both the short and long-term form flash floods.

If any slips occur in the excavations, banks or filling during the execution of the Works or during the period of maintenance form any cause whatsoever, the Contractor shall execute the necessary remedial work in such manner, and with such materials as approved by the Employer, at the Contractors expense.

The Contractor shall make good all settlement of filling that may occur up to the end of the period of defects liability at his own expense.

7.5.4 Road work and surfacing for power plant access

7.5.4.1 General

Approach road is the road from connecting road up to the gate for the power plant building.

Approach road shall be concrete surfaced roads of properly graded, compacted and surfaced. Access roads shall be soil filled surface roads suitable to carry wind generator masts and other construction machineries.

7.5.4.2 Materials

Material for the hard-core shall consist of natural stone broken to pass a 100-mm ring. It shall be free from dust, rubbish, wood, vegetable or other injurious matter.

Broken stones and aggregates shall consist of hard crushed natural stone or gravel of approved sizes.

7.5.4.3 Road sides

Kerbs

ln-situ concrete kerbs or pre-cast concrete kerbs set on a concrete bed are to be laid on each side of the roads, to define the limits for vehicular access.

Drain

All drains, sewers, cable ducts and other necessary work below road formation level shall be completed, inspected and passed by the Employer before any road work is started.

Paving slabs and trench covers

Concrete paving slabs shall comply with a relevant approved standard.

Trench covers shall be minimum of 50 mm thick and provided with handles or holes for lifting purposes. They shall be reinforced to the approval of the Employer. The reinforcement shall be in the middle of the covers with 25mm cover to the edges. Trench covers shall comply with the relevant standard as approved.

Where concrete covers are required for trenches crossing roads, these shall be designed for the heavy wheel loads expected on them and shall be reinforced with mesh fabric or mild steel bars as necessary.

Stone surfacing

Stone chipping used for substation surfacing are to be clean hard crushed stone graded from 16 - 40 mm.

The formation in areas where stone chipping are to be used shall be well compacted to the approval of the Employer, and treated with an approved total weed killer, used in accordance with the manufacturer's instructions.

Stone chipping shall be laid and lightly compacted to a minimum finished thickness of 100 mm.

3.5.5 Concrete

3.5.5.1 General

Standards of design, materials and workmanship are to be equal to or better than those laid down in British Standard BS 8110. An approval from the Employer should be obtained for trial mix, for all grades of concrete specified in the design, from a test laboratory approved by the Employer.

3.5.5.2 Materials

Cements

Sulfate resisting cement complying with all the requirement of BS 4027 shall be used in this project.

The Bidder shall indicate the brand name, manufacture and source of the cement which he proposes to use in the Works and the method of delivery. The Contractor shall not place the order for cement before the Employer's approval is obtained. All cement shall be obtained from the same source for any particular part of a structure.

The Contractor shall not use cement varying from that used in the preparation of trial mixes until any further trial mixes required by the Employer have been made and tested and shown to comply with the specification.

The cement shall be tested to determine the total alkali content in accordance with ASTM C114-69 (Chemical Analysis of Hydraulic Cement) or BS 4550: Part 2. The equivalent weight of sodium oxide shall be calculated from the formula given in BS 5328 part 4.

The equivalent weight of sodium oxide shall not exceed 0.6% of the weight of cement. The above restriction shall be waived if the proposed aggregate is proved without doubt to be non-reactive.

The Contractor may use cement delivered in bulk; delivery arrangements shall be to the Employer's approval and each delivery must be accompanied by a manufacturer's test certificate.

Each consignment of cement shall be brought to the site in sufficient time to allow any tests to be carried out before the cement is used.

Cement in bags shall be unloaded under cover and stored in a well-ventilated and weatherproof building used exclusively for this purpose. The floor of the building shall be at least 150 mm off the ground and an air space shall be left between the floor and bottom layer of bags.

Each consignment shall be stacked separately so as to permit easy access for inspection and a record shall be kept so that each consignment may be identified. Storage shall be arranged so that the cement is used in order to delivery.

Cement which is more than 12 weeks old from the date of manufacture shall be retested on site for fineness, setting time, strength and soundness in the presence of the Employer's representative and full test reports shall be submitted within 24 hours.

Test certificates and samples

All cement shall be certified by the manufacturer as complying with the requirements of the appropriate specification. The Contractor shall, when required by the Employer, obtain for him the manufacturers test certificate for any consignment as soon as possible after delivery.

For every 50 tons of cement delivered to site and whenever required by the Employer the Contractor shall take samples, under supervision, from the cement stored on, or delivered to the site. The Contractor shall test such samples as specified in this document.

The fine and coarse aggregates shall comply with BS 882.

The sources for all aggregates shall be approved by the Employer.

Physical requirements

(a) The weight of voided shells in fine aggregate shall not exceed 5%.

(b) The weight of the clay and fine silt fraction (smaller than ASTM sieve No. 200) shall not exceed 5% by weight of coarse aggregates or 10% by weight for fine aggregates.

(c) Absorption of fine and coarse aggregate shall not exceed 5% as measured in accordance with BS 812 or similar standard.

(d) The soundness of all aggregates shall be proved by a sodium sulfate test in accordance with ASTM C88-73, from which the loss over 5 cycles shall not exceed 10% for fine aggregates or 12% for coarse aggregates.

(e) The apparent specific gravity of aggregates as determined by an approved test, such as in BS 812, shall not be less than 2.5.

(f) Los angles abrasion shall not exceed 37%.

Where quarries with aggregate from bedrock, especially limestone of the Dolomite type, the rock shall be checked for surface alteration to hardpan. This may affect the surface for well over a meter depth and result in salt concentrations near the surface. Such rocks are also prone to other undesirable characteristics including pockets of clay, salt, chalk or other friable material. Rigorous initial physical inspection is essential.

Chemical requirements

(a) Fine and coarse aggregates shall not be potentially reactive with alkalis, and shall be tested in accordance with BS 812.

(b) Fine and coarse aggregates shall not contain more than 0.5% by weight of acid soluble sulfates (as S03).

(c) Fine aggregate shall contain no more than 0.1% by weight of chlorides (as NaCl) and coarse aggregate more than 0.03%. Should these figures be exceeded the aggregate may still be considered acceptable in this respect provided the total sodium chloride concentration is not greater than 0.32% by weight of cement in the mix, irrespective of the origin of the chloride.

The aggregates shall be stored at mixer positions in such a manner that intermingling of different sizes and types of aggregates is prevented. The stockpiles are to be protected from rubbish or windblown dust.

Heaps of fine aggregate shall be capable of draining freely. Wet fine aggregate shall not be used until, in the opinion of the Employer, it has drained sufficiently to ensure proper control of the water/cement ratio.

Water

The water used for making concrete, mortar and grout shall be clean, fresh and free from injurious amounts of soil, vegetable or organic matter or any other deleterious substance in suspension or solution. The mix water shall be continually monitored for salt content and the concrete mix designed accordingly to limit total salt content. The water should comply with the requirements of SLS 522.

Admixtures

Admixtures shall not be used without the approval of the Employer. Before the use of any admixture can be approved the Contractor must prove by trial mix procedures that the concrete will in no way be adversely effected even when twice the recommended dose is batched.

7.5.5.3 Workmanship

Concrete strength requirements

All concrete mixes shall be in accordance with the requirements of BS 5328 and BS 8110 as designated on drawings approved by the Employer.

At least 7 days before concrete construction is programmed to commence the Contractor shall submit for approval all the details of concrete mix designs for each proposed grade of concrete. No concrete construction may be commenced until this data is approved by the Employer.

The strength requirements for each grade of concrete proposed in the design shall be proven by means of preliminary trial tests as specified in BS 5328 and BS 1881. The minimum cement content and the maximum free water-cement ratio shall be in accordance with BS 8110 and BS 5328.

The Contractor's designs and drawings shall show clearly the characteristic strengths, and permissible deviation proposed for each grade of concrete to be used. The Contractor shall carry out frequent tests to the satisfaction of the Employer to check the relationship of the strength of concrete cured under site conditions to that cured under laboratory conditions.

Mixing

All concrete except where specifically permitted by the Employer in writing shall be mixed in mechanical mixing machines. The machines shall have a large water storage tank with a tested quality water for concreting. The dry concrete ingredients shall be mixed until a uniform color is obtained after the addition of the water the concrete shall be mixed for a further 2 minutes or until a uniform color is achieved. The total water in the mix shall not exceed the amount used in the trial mix.

In computing the quantity of water to be added, due account must be taken of the water contained in the aggregates. The amount of water shall be sufficient to ensure through hydration, good workability and high strength.

The Contractor shall take all precautions to the satisfaction of the Employer to protect the concrete from the injurious effects of the elements.

Workability

The concrete shall be of such consistency that it can be readily worked into the corners and angles of the framework and around reinforcement without segregation of the materials or bleeding of free water at the surface. On striking the framework it shall present a face which is uniform, free from honeycombing, surface crazing or excessive dusting, and which shall not, in the opinion of the Employer, be inferior to the standards laid down in later clauses in this section. In order to satisfy the Employer that adequate for the requirements of the Specification, the Contractor shall carry out a series of workability tests on the preliminary trial mixes required elsewhere in this Section. These tests

shall be carried out in accordance with BS 1881, or such other procedure as approved by the Employer.

The samples to be tested shall be obtained from the batches used for the preliminary test cubes. In addition the Contractor shall supply for each of the grades of concrete a section of framework complete with reinforcement fixed in position and generally representative of the sections commonly to be employed in the Works. The capacity of this trial section of formwork shall be at least half a batch of concrete but in any case not less than 1/4 cubic meter. The formwork shall comply with the requirements of this Specification for formwork. The mould shall be filled in the presence of the Employer with concrete of the same mix and batch from which the preliminary test cubes are made and shall be compacted in the same manner with the same equipment as are proposed for the Works. This procedure shall, if necessary, be repeated with modified mixes until the appearance of the concrete after striking the mould is acceptable to the Employer, after which it shall be used as the standard for that grade.

When specific workability is called for a check it shall be maintained by measuring slump at the rate of one test for each 10 cubic meters of concrete or three tests for each day of concreting.

Transportation

The concrete shall be discharged from the mixer and transported to the Works by means that shall be approved by the Employer and which shall prevent adulteration, segregation or loss of ingredients, and ensure that the concrete is of the required workability at the point and time of placing.

The concrete shall be placed in the positions and sequences indicated on approved drawings, in the Specification or as directed by the Employer, within one hour of mixing. All formwork and reinforcement contained in it shall be clean and free from standing water, immediately before the placing of concrete.

The Employer shall be given 24 hour notice in order that he may check the work.

Except where otherwise directed, concrete shall not be placed unless the Employer or his representative is present or he has previously examined and approved the positioning, fixing and condition of the reinforcement and of any other items to be embedded, the cleanliness, alignment and suitability of the containing surfaces, and the adequacy and condition of plant.

The concrete shall be deposited as nearly as possible in its final position and in such a manner as to avoid segregation displacement of the reinforcement, formwork or other embedded items. Placing shall be continuous between specified or approved construction joints.

All small concrete pours shall be carried out in the late afternoon.

Where chutes are used to convey the concrete, their slopes shall not be such as to cause segregation and suitable spouts or baffles should be provided to obviate segregation during discharge. Concrete shall not be allowed to fall freely more than 1.5 meters except with the approval of the Employer. Where pneumatic placers are used the velocity of discharge shall be regulated by suitably baffles or hoppers where necessary to prevent segregation damage and distortion of the reinforcement, other embedded items and formwork, caused by impact.

If concreting is not started within 24 hours of approval being given, approval shall again be obtained from the Employer. Concreting shall then proceed continuously over the area between construction joints. When in-situ concrete has been in place for 4 hours, or less as directed by the Employer depending upon the mix, type of cement and weather conditions, no further concrete shall be placed against it for a further 20 hours.

Concrete, when deposited, shall have a temperature of not less than 5°C and not more than 32°C. It shall be compacted in its final position within 30 minutes of discharge from the mixer when the time shall be within 2 hours of the introduction of cement to the mix and within 20 minutes of discharge from the agitator.

Except where otherwise agreed by the Employer, concrete shall be deposited in horizontal layers to a compact depth not exceeding 450 mm where internal vibrators are used or 300 mm in all other cases.

When chutes are used they shall be kept clean and used in such a way as to avoid segregation.

Compaction

The concrete shall be fully compacted throughout the full extent of the layer. It shall be thoroughly worked against the formwork and around reinforcement and other embedded items, without displacing them. Successive layers of the same lift shall be thoroughly worked together.

All concrete shall be compacted to produce a dense homogeneous mass. Unless otherwise agreed by the Employer, it shall be compacted with the assistance of vibrators. Sufficient vibrators in serviceable conditions shall be on site so that spare equipment is always available in the event of breakdowns.

Vibration shall not be applied by way of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided, so far as is practicable.

Concrete shall not be subjected to vibration between 1 and 10 hours after compaction.

Unless otherwise directed by the Employer, approved power driven vibrators of the immersion type shall be used. They shall be inserted at such distances apart or applied in such a manner as will ensure that the concrete being placed.

Vibrators shall penetrate the fully depth of the layer and where concrete is placed over previously placed concrete not more than 4 hours old the vibrators shall enter and revibrate that layer to ensure that successive layers are well knitted together.

Over-vibration, causing segregation, surface laitance or leakage through formwork, shall be avoided. Immersion vibrators shall be withdrawn slowly to prevent the formation of voids. Vibrators shall not keep damage to formwork or other parts of the structure, or displace the reinforcement or other embedded items.

Internal vibrators shall be capable of producing not less than 10,000 cycles per minute and external vibrators not less than 3,000 cycles per minute.

Construction Joints

Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be indicated on the drawings and approved by the Employer. When not indicated on the drawings the following generally rule shall apply:

Joints in columns are to be made at the underside of floor members and at floor levels. Haunches and column capital are to be considered as part of and continuous with the floor or roof.

Floors joints in the floor system are to be located' at or near the quarter points of the span in Slabs and beams, except where otherwise instructed.

Walls Vertical joints away from corners. Horizontal joints above sprays or openings.

Whenever the placing of the concrete is discontinued other than at the exposed faces, this discontinuity shall form a construction joint. Construction joints are to be made only along a horizontal or vertical plane except that in the case of inclined or curved members they shall be at right angles to the principal axis.

Care shall be taken to prevent offsetting of the joint and to ensure water-tightness. The joints shall in every way satisfy the requirement of the Employer, and be fully detailed on drawings prior to submission for approval.

When work is resumed adjacent to a surface, which has set, the whole surface shall be thoroughly roughened. It shall be cleaned of all loose and foreign matter and laitance and washed with Water immediately before placing the fresh concrete, which shall be well compacted, against the joint.

Construction bays

The Contractor shall agree with the Employer, prior to the commencement of Concreting, upon the sequence of placing concrete and the positions of vertical and horizontal joints, whether shown or not on the drawings.

Expansion joints shall be fully detailed on construction drawings before submission for approval.

Expansion joints shall be filled with bitumen impregnated fiber board to full depth and width. The infilling will be permitted to use as permanent formwork only for second casting. Where the fiber board is exposed it shall be cutback for a depth of at least 2cm from the chambered edge, filled and pointed with a resilient liquid polysulphide polymer sealant to the manufacturer's instructions.

Where dowel bars are indicated on the Drawings forming part of a joint, they shall be held securely horizontal and perpendicular to the joint during Concreting.

Dowel bars shall be plain mild steel bars conforming to BS 4449.They shall be straight and coated with approved bond breaking compound, which shall consist essentially of 66% of 200 penetrating bitumen blended hot with 14% light creosote oil and, when cold, brought to the consistency of paint by the addition of 20% solvent naphtha, or other approved compound.

Plastic caps used in expansion joints shall be rigid and securely fixed to the dowel to prevent the ingress of concrete during casting of the slab. The packing used within the cap shall be an inert, compressible material. All dimensions must be shown on Drawings prior to submission for approval.

Joining new concrete work to existing

Existing concrete shall be broken out as described or directed and scrabbled to form a suitable key for the new concrete. Where necessary the reinforcement in existing concrete shall be exposed, cleaned and bent to its correct shape. New reinforcement shall be securely wired to the existing.

Immediately before new concrete is poured, a bonding agent approved by Employer, shall be applied to the existing concrete faces.

Curing

Concrete shall be protected during the first stages of hardening from the harmful effects of sunshine, drying winds, cold, rain or running water. The protection shall be applied as soon as practicable after completion of placing by a method to be approved by the Employer. The Contractor shall put forward his proposals for curing concrete to the Employer for approval, before any Concreting work commences.

On vertical surfaces, the curing membrane shall be applied immediately after removing the formwork.

No concrete shall be allowed to become alternately wet and dry. The temperature of curing water shall be same as the concrete + 5 ° C. General Concrete shall be wet-cured for at least 7 days with a further 4 days of dry protection.

All concrete shall be covered for at least 14 days after placing and kept continuously wet for the initial 7 days. The temperature of curing water shall be within 5°C of that of the concrete. Air shall not be permitted to circulate between concrete and curing materials.

Placing

Placing shall not commence until sufficient standby pumps and vibrators are on site to cope with breakdowns.

No concrete shall be batched until formwork is ready and all reinforcement fixed in place approved by the Employer.

The area of each concrete pour frontage shall be kept to a minimum and suitable means shall be provided to avid premature stiffening of concrete placed in contact with hot dry surfaces. Where necessary the surfaces, including reinforcement, against which the concrete is to be placed, shall be shielded from the rays of the absorption by the surfaces of water from the fresh concrete.

In hot weather concrete shall be deposited in horizontal layers to a compacted depth not exceeding 300 mm and internal mechanical vibrators shall be used.

Due to rapid stiffening in hot weather all clean-up operations such as application of resin cure membranes and dust reducers, and surface finishing, etc. shall follow closely behind final tamping.

Testing

Initially, the Contractor shall double the number of test cubes made. Half of them shall be cured under site conditions in order to ascertain the relationship between site-cured samples and lab-cured samples. The number of slump tests shall initially be twice that normally required. Air temperature shall be measured every two hours, and the temperature of every batch of concrete shall be recorded as it is deposited at the work place.

7.5.5.4 Testing

Testing methods are to be in accordance with the relevant BS or ASTM standard except as approved or requested by the Employer.

The Employer shall have the right to order that any materials which, do not meet with his approval shall not be used in the work. The Contractor shall have the right to sample, test and give his opinion on such materials. If after this, the materials which, are rejected by the Employer shall be immediately removed from the Site by the Contractor.

The Contractor shall provide the Employer with Facilities for materials testing on Site. The Facilities may be those normally used by the Contractor.

All testing Facilities on site shall be calibrated at regular intervals in the presence of the Employer, and whenever deemed necessary by the Employer.

Works test cubes

Before commencing any Concreting work the Contractor shall submit for approval his proposed testing regime for the Works concrete. If the proposals are not approved by the Employer, the Contractor shall comply with the next two paragraphs below.

For the first 10 days that a particular grade of concrete is produced, or where there is a lapse of two weeks or more between successive pours of the same grade of concrete, three samples shall be taken on each day and three cubes shall be made from each sample. Two shall be tested at 7 days and the other at 28 days.

After the initial 10 days, samples of designed mixed shall be taken at the reduced rate given in Table below, with the provision that at least one sample shall be taken on each day that concrete of that grade is used. Three cubes shall be made from each sample, one being tested at 7 days and the remaining two at 28 days.

Sampling rates for design mixed after day

Run-in of concrete grade

(Cubes shall be made from each sample)

RATE	TYPE OF STRUCTURE	SAMPLE TO BE TAKEN EVERY
A	critical structure	
	E.g. Foundations, Cantilevers, Columns	10 cum.
B	Intermediate Structures	
	E.g. Beams, Slabs,	40 cum.

The cubes shall be made, cured, stored and tested in compression in accordance with BS 1881. The tests shall be carried put in a testing laboratory approved by the Employer. The laboratory must provide evidence that is equipment and procedures comply with BS 1610 and BS 1881. The calibration test reports of testing machines and details of the qualifications of all laboratory staff shall be submit for approval if requested by the Employer.

Reports of all tests made shall be supplied direct from the laboratory to the Employer within 24 hours of the cube being tested. The Employer's Representative on site shall have the authority to stop all further concrete work until acceptable test results are forthcoming.

Up-to-date records shall be kept by the Contractor at Works of positions in the Works of all batches of concrete, of their grade and of all test cubes, cores and other specimens taken from them. Copies of these records shall be supplied to the Employer at weekly intervals or upon request by the Employer.

Compliance of works test cubes with specification
When submitting proposed testing regimes the contractor shall also detail his proposed acceptance criteria for the Employers approval. When this is not forthcoming the Contractor shall comply with the next two paragraphs below

The rules compliance for works cubes are different to those for Trial Mixes. Compliance with the characteristic strength shall be assumed if the conditions given in both (1) and (2) are met:

(1) The average strength determined from any group of four consecutive test results exceeds the specified characteristic strength by

    3 N/mm^2 for concrete of grade C20 and above (i.e.) characteristic strength = 20 N/mm^2

    2 N/mm^2 for concrete of grade C15 and above (i.e.) characteristic strength = 15 N/mm^2

(2) The strength determined from any test result is not less than the specified characteristic strength minus.

    3 N/mm^2 for concrete of grade C20 and above

    2 N/mm^2 for concrete of grade C15 and below

The quantity of concrete represented by any group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

When a test result fails to comply with (2), only the particular batch from which the sample was taken shall be at risk.

Compliance criteria remain the same irrespective of varying rates of sampling of the same grade concrete in different structures.

Where a minimum or maximum cement content of a designed mix is specified and compliance is assessed by observation of the bathing or from auto graphic record, the cement content shall not be less than 95% of the specified minimum or more than 105% of the specified maximum.

Where compliance of cement content is assessed from the results of analysis tests on fresh concrete, the cement content shall not be less than 90% of the specified minimum or more than 110% of the specified maximum.

Failure of concrete to meet test requirements

If the strength of the specimen is less than the appropriate specified minimum crushing strength or if, in the opinion of the Employer, the concrete fails to meet the specified requirements in other respects, the concrete in that part of the Works of which, it is a sample will be considered not to comply with the specified requirements.

As and where directed by the Employer, cylindrical core specimens shall be cut from the handed concrete in the Works for purpose of examination and testing. The cutting equipment and the method of doing the work shall be made available for examination of the Employer. Testing of the core shall be in accordance with approved standards.

Recourse also be made by the Employer to such non-destructive means of testing as ultrasonic pulsing and Schmidt rebound hammers.

If the specified requirements have not been met the Contractor shall propose such remedial action as may be required. Such action is subject to the Employer's satisfaction and approval. If no satisfactory remedial measures are proposed by the Contractor and approved by the Employer then the Employer shall order the removal of all work not complying with the Specification at the Contractor's expense. Before proceeding with similar work the Contractor shall submit to the Employer for his approval details of action proposed to ensure future concrete to be placed in the works would comply with the Specification.

7.5.5.5 Formwork

Forms shall be so designed and constructed that the concrete can be properly placed and thoroughly compacted. The forms shall be of plywood at least of 12mm thickness conform accurately to the required shape; position and level, subject to the tolerance specified and to the standards of finish of hardened concrete as specified and to the standards of finish of hardened concrete as specified later this Section.

The Employer may request the Contractor to provide sample panels of formwork for approval, at the Contractor's expense.

When concrete is to be vibrated, special care shall be taken to maintain the stability of the formwork and the tightness of the joints during vibrating operations.

The material and position of any ties passing through the concrete shall be approved by the Employer. The whole or part of the ties shall be capable of being removed so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement. Any holes left after the removal of ties shall be filled unless otherwise directed by the Employer with concrete or mortar of approved composition.

Removal of formwork

All forms shall be removed without damage to the concrete. The use of mould oil or other material to Facilities this shall be subject to the approval of the Employer. All formwork for pits, ducts and holding down bolt holes must be so constructed that it can be easily collapsed to facilitate withdrawal after the initial set of the concrete.

The Contractor's proposed method for the construction and fixing of the formwork for bolt hole pockets shall be submitted to the Employer for approval before construction. The top of the shuttering shall be suitably covered to prevent entry of excess grout, materials used for curing, etc.

Solid timber must not be used for forming holding down bolt holes. Bolt holes former may be made of plywood, expanded metal, polystyrene or other method approved by the Employer, who may require the Contractor to carry out a test pour, using the proposed bolt hole former. The Employer shall be informed in advance when the contractor intends to strike any formwork.

The time at which the formwork is struck shall be Contractor's responsibility. The formwork may be struck when the concrete has in the opinion of the Employer attained a compressive strength of not less than 10 N/mm2 or twice the stress to which it will then be subjected whichever is the greater.

In the absence of cube test results the minimum periods before striking form work for concrete made with sulfate resisting cement shall be according to the table 6.2 of BS 8110. Formwork shall be constructed so that the side forms of members can be removed without disturbing the soffit forms and if props are to be left in place when the soffit forms are removed these props shall not be disturbed during the striking.

Finishes

The Contractor shall state precisely on his plans which of the type of finished described hereunder he intends to use in the various locations. Any defective concrete finish will be rejected. The Employer

may at his discretion order the defects to be cut out and made good. Plastering of defective concrete as means of making good will not be permitted, except that in the case of minor porosity in the surface the Employer may approved a surface treatment by rubbing down with cement and sand mortar of the same richness as in the concrete. This treatment shall be immediately after removing the formwork.

Formed finishes for concrete

Type F.1

This finish is for surface against which backfill or further concrete will be placed. Formwork shall consist of sawn boards, sheet metal or any other suitable material, which will prevent the loss of grout when the concrete is vibrated.

Type F.2

This finish is for surfaces, which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a Type F.2 finish shall be faced with wrought and thickened board with square edges arranged in a uniform pattern. Alternatively, plywood or metal panels may be used if they are free from defects likely to detract from the general appearance of the finished surface. Joints between the board and panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fines, surface discoloration and other minor defects shall be remedied by methods approved by the Employer.

Type F.3

This finish is for surfaces prominently exposed to view where good appearance and alignment are of special importance. To achieve this finish, which shall be free of board marks, the formwork shall be face with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved uniform pattern. Whenever possible joints between sheets shall be arranged to coincide with architectural feature, sills, window heads or drainage in direction of the surface. All joints between panels shall be vertical and horizontal unless otherwise directed.

Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surface. Unfaced wrought boarding or standard steel panels will not be permitted for Type F.3 finish. Permanent forms shall be constructed of slabs or blocks of precast concrete, natural stone, brickwork or other approved material as directed. Such slabs or blocks shall have an exposed surface of the quality shown on the Drawing sand as specified. They shall be fixed to the structure by approved means and the joints between them shall be made tight with mortar or other means of preventing leakage. The use of internal metal ties shall not be allowed.

Type F.4

This finish is identical to Type F.3 except that internal metal ties are permitted.

Uniformed finishes to concrete

Type U.1

This is a screeded finish for surfaces of roads or of foundations, beds, slabs and structural members to be covered by backfill, subsequent stages of construction, bonded concrete, topping or cement mortar beds to receive paving and on exposed surfaces or paving where superior finish is not required. It is also the first stage for finished Type U.2 and U.3. The finishing operations shall consist of leveling and screeding the concrete to produce a uniform plane or ridged surface, surplus concrete being struck off by straight edge immediately after compaction.

Type U.2

This is a floated finish for surfaces of beds and slabs to received mastic paving or block or tie paving where a hard smooth steel-trowelled surface is not required. Floating shall be done by hand or machine. Care shall be taken that the concrete is worked no more than is necessary to produce a uniform surface free from screed marks.

Type U.3

This is a hard smooth steel-trowelled finish for surface of concrete paving, topes of walls, exposed surfaces of engine and plant foundations and in the vicinity of holding down bolt chases, copings and other members exposed to weathering, surface bed and slabs to receive thin flexible sheet and tile paving bedded in adhesive and settings for bearing plates and the like where the metal is in direct contact with the concrete. Trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked to the surface. The surface shall be trowelled under firm pressure and left free from trowel marks.

Surface treatments

Where concrete is to be treated with sodium silicate or a similar dust preventive coating this must be carried out within 14 days of the Concreting of the foundation and be applied in accordance with the manufacturer's instructions.

7.5.5.6 Reinforcement

Steel reinforcement shall be one of the following:

(a) Hot rolled mild steel round bars complying with BS 4449 or equivalent standard, as approved by the Employer.

(b) High tensile steel either

I. Cold worked deformed bars complying with BS 4461 (or 4482) or

II. Hot rolled deformed bars complying with BS 4449, or approved by the Employer.

(c) Welded steel mesh reinforcement complying with BS 4483 or similar approved.

(d) Bars greater than 40mm diameter will not generally be used.

Reinforcement shall be stored clear of the ground on sufficient supports to prevent distortion of the bars. Mild steel and high tensile steel are to be stored separately.

The Contractor shall supply the Employer with a certificate for each consignment from the steel manufactures showing that the steel meets the requirements of the Specification. One tension test and one bond test shall be made for each lot of 50 tons of less supplied for the permanent Works.

Steel reinforcing bars shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, mortar earth, paint or any material which may impair the bond between the concrete and the reinforcement, or which may cause corrosion of the reinforcement or disintegration of the concrete.

Reinforcement may be bent on site, or alternatively off the site, by an approved method. The Contractor shall arrange for bending equipment suitable for bending both mild steel and intermediate grade bars. Mild steel shall be bent at temperatures in the range 5 °C to100 °C High tensile steel shall only be heated or welded when the manufacturer given written guarantees as to its subsequent performance. The shapes of the bends and lengths must comply as specified on the Drawings and Bending Schedules as approved by the Employer.

The contractor shall provide any chairs or other subsidiary reinforcement necessary to keep the reinforcement in its correct position. The concrete cover over such subsidiary reinforcement shall not be less than that over the reinforcement generally.

The Contractor shall provide adequate scaffold boards to ensure that the reinforcement is not displaced by being walked upon during the placing of the concrete or other operation.

Mesh reinforcement shall be fixed flat in the works over the whole of the areas indicated on the approved drawings. Adjoining sheets of mesh shall overlap by at least 300mm.

Loose small pieces of fabric shall only be used where they are essential for fitting in to small confined parts of the Works. Areas of fabric reinforcement shall be net with no allowance included for laps or waste. Fabric reinforcement shall be delivered to site only in flat sheets.

Bends, cranks and other shapes of reinforcement shall be to the dimensions specified; otherwise all bars shall be truly straight. Bending of reinforcement shall be carried out round a former having a diameter of at least four times the diameter of the bar.

The bending dimensions shall comply with BS 4466 unless otherwise specified on the bending schedules.

Cover blocks used for the correct positioning of reinforcement shall be of a type approved by the Employer. They shall be rigid, inert and capable of supporting the reinforcement in its correct position with the required cover without deforming. They shall not impair the finish on the correct no cause the formwork to deform locally.

Reinforcing bars shall be tied together at every intersection using 16 SWG soft pliable annealed steel wire. Immediately prior to Concreting all reinforcement shall be wire brushed to remove all wind-blown contaminates such as salt.

Concrete cover to all reinforcement (including stirrups) shall be as specified in BS 8110 and BS 8004. In addition, the cover shall never be less than the diameter of the main bar or nominal maximum size of the aggregate.

Testing of reinforcement

The Employer shall have the right to select at any time samples of steel reinforcement for testing in accordance with the relevant approved standard.

Bar bending schedules

The Contractor shall provide fully dimensioned bending schedules giving the location and bending of every bar shown on the drawings. Unless otherwise stated on the Bending Schedules all bars shown will be dimensioned in accordance with the national or international standard to be approved by the Employer, e.g. British Standard 4466.

Prevention of corrosion below ground

The Contractor is to ascertain whether or not the sub-strata contain any corrosive qualities, which will have a deleterious effect on reinforced concrete. If such conditions are evident, only an additive approved by the Employer is to be incorporated in the concrete mix in the proportions according to the manufacturer's recommendations.

7.5.5.7 Transportation and storage of steelwork

All steel work shall be transported, lifted and generally handled in a manner that does not affect the shape or surfaces of the section. Lifting slings shall be of nylon rope; chains and hooks shall not be used in contact with the steelwork. The position of lifting points used on sections shall be such that the stresses induced in the sections do not exceed one half of the yield stress of the materials.

Steelwork shall be stored in clean, dry conditions off the ground. Separate pieces of steelwork shall have spacer blocks between them.

7.5.5.8 Erection

The Contractor must provide all temporary works, of any kind whatsoever, he shall deem necessary to ensure the correctness of alignment, plumbing and stability of the various frames and members.

During erection the work shall be securely bolted or otherwise fastened and, if necessary, temporarily braced to provide safety for all erection stress and conditions, including those due to erection

equipment and its operation. No permanent bolting of high strength friction grip bolts shall be done until proper alignment has been obtained.

7.5.6 Metal work

7.5.6.1 General

All metals and metalwork components whether fabricated on or off site shall confirm to the requirements of the relevant British Standards or any other standards to the approved by the Employer.

Metalwork articles shall have a good finish, and de free from scale, rust, damage or other defects.

Components shall be properly assembled and jointed in a neat and functional manner. Welded connections shall be ground off as necessary to present a clean smooth finish without detriment to the strength of the connection.

All metal and metalwork components shall be galvanized according to the BS EN ISO 1461:2009.

7.5.6.2 Hand railing

Hand rails and uprights shall be from 50 mm diameter galvanized pipes and finished with enamel paint.

7.5.6.3 Checker plate

Mild steel checker plate (raised pattern) shall be fabricated from first grade mild steel with a minimum thickness over the plain portion of 6 mm. Weight of individual panels shall not exceed 30 kg. All mild steel checker plate shall be galvanized after cutting to their required size.

7.5.6.4 Door & Window frames

External doors shall be fabricated from aluminum sheet covering a framework of angle sections. Doorframes shall also be aluminium. All external doors shall be insulated and fitted with panic latches, which are lockable from outside. Door sashes and frames shall be powder-coated with approved door.

External doors shall be effectively sealed to reduce the ingress of dust as far as practicable using heavy duty seals which shall be guaranteed for minimum period of five years from date of commissioning. Doors and seals shall be designed that replacement of worn seals can be achieved easily on site

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7.5.6.5 Aluminium windows and doors

Aluminium windows and doors shall be obtained from an approved manufacturer and of a type, design, color and finish to be approved by the Employer.

Aluminium windows and door frames are to be formed of extruded aluminium sections to EN AW 6063 and of aluminium alloy type T5 or above or such other alloy approved by the Employer as being suitable for the climatic and atmospheric conditions prevailing at the site. Applicable standards are BS EN 12020, BS EN 755, BS EN 515 and BS EN 573

Anodizing should be accordance with BS EN ISO 7599 and BS EN ISO 2360. Powder coating should be according to BS 6496.

All aluminium sections shall be 70mm or above.

The construction of aluminums windows, including weather-stripping, hardware, etc., is to comply with the requirements of BS 4873 or other approved standard.

Where possible, aluminium windows and doors shall be fixed after all structural and wet finishes are completed but in any case they shall be kept clean and protected from damage at all times. Splashes of cement, plaster, etc., which occur on the aluminium during the construction period shall be immediately cleaned off.

Care shall be taken during dispatch and storage on site to prevent damage to the windows and doors.

Allowance shall be made when fixing frames for expansion to aluminium members so as to prevent distortion of frames or cracking of glass. The perimeter of the frame shall be pointed with approved mastic.

7.5.6.6 Other materials

Materials not herein fully specified and which may be offered for use in the works shall be first class quality and of such kind as is generally used in first class work. The Employer shall have the right to determine whether all or any of the materials offered or delivered for use in the works are suitable for the purpose. External ferrous metalwork shall be galvanized.

7.5.6.7 Workmanship

All plates and sections shall be true to form, free from twist and straightened before any fabrication work is started on them. Each piece of work shall be distinctly marked before dispatch accordance with a marking diagram to be provided by the Contractor.

7.5.7 Block work

7.5.7.1 General

All work shall be carried out in accordance with BS 5628.

All blocks shall be kept damp during building and shall be laid on a full bed or mortar. All joints shall be completely filled with mortar. The thickness of the horizontal mortar joints shall not exceed 40 mm to every four joints. Where block work are to be plastered or rendered, joints shall be struck off and left rough to provide a key.

Movement joints shall be provided where required. They shall incorporate a joint filling strip and sealant. Gaps in movement joints shall be left free from debris and shall not be pointed with mortar.

Block work shall be built with three courses to 600 mm in uniform manner, in truly level courses and truly vertical or battered. Corners and other advanced work shall be racked back and not raised above the general level more than one meter Toothing shall be used only where provision has to be made for a future extension.

Both leaves of cavity walls shall be built up simultaneously. Galvanized flat twist wall ties of an approved pattern shall be bedded with a slight fall towards the outer face and shall be provided in alternate courses at intervals of 900 mm and staggered horizontally. Additional ties shall be used near the sides of all openings at the rate of one for each 300 mm of opening height. The cavity shall be kept clear of mortar droppings and rubbish, and the inside mortar joints shall be finished flush as the work proceeds. Cavities shall be 50 – 75 mm in width.

Weeps holes shall be built in to the external skin of cavity walls in the form of sand filled vertical joints at 1m centers and are to be racked out on completion. Weep holes shall be placed over all lintels or other significant obstructions to the cavity.

Where so described or directed reveals and piers, together with airbricks, fixing bricks for jointer's other work and other relevant items shall be built in as the work progresses.

Walls shall be constructed with an approved metal reinforcement every second course. Additional horizontal reinforcement shall be provided in bed joints in walls for each 2 courses above and below all openings greater than 300 mm wide. The reinforcement shall extend a minimum of 900 mm beyond the opening on both sides.

Below ground level and at the jambs of all openings, the hollow concrete blocks shall be filled with weak concrete, well-tempered down and carried from base slab to top of such openings. Cavities shall be kept clear of mortar droppings or other debris, by the use of lifting battens or other suitable means.

Where block work is built against steel columns, provision should be made to tie the block work to the columns every second course, by means of a rod welded to the steel columns and bedded into the block work.

Where external block work abuts concrete surface and where indicated elsewhere the blocks shall be tied to the concrete every second course with adjustable galvanized steel ties fixed is slots cast into the concrete.

Concrete abutting external block work shall be coated with two coats of bitumen paint.

Holes and chases shall be cut out or left in the walls as required, as provision shall be made for making good to the satisfaction of the Employer.

On completion, all block work shall be cleaned down and mortar dropping and other marks removed. Defective blocks or workmanship shall be made good. Architectural features, finished surfaces and quoins shall be protected against damage during the progress of the works. Sills, jambs and heads shall be protected by casings as soon as built.

All natural stone, cast stone and precast concrete copings, sills, lintels, dressings and any similar item shall be hoisted into position and bedded, jointed and pointed in 1:1:6 cement mortar or as described or directed.

7.5.7.2 Materials

Cement

Cement quality shall be as described in the section for concrete. The clause in that section referring to cement storage shall also apply.

Fine aggregates

Fine aggregates for forming blocks shall be aggregates from natural source of hard, durable material or other approved, free from deleterious substances. Sand shall be graded 2 mm down and coarse aggregate shall have no particles larger than 10 mm. Sands for blocks shall be as specified for concrete.

Cement hollow blocks

Precast cement hollow blocks shall comply with SLS 855 and shall have a minimum compressive strength of individual block 2.8 N/mm2. Minimum average compressive strength of samples shall be 3.5 N/mm2 for non-load bearing walls. Density of blocks shall not be greater than 1500 kg/cum. Blocks shall be manufactured in an approved machine and vibrated then cured for at least seven days. Blocks shall not be used in the works for at least 14 days after manufacture.

All blocks shall be stacked by hand on approved hard standings. They are to be stored in orderly stacks so arranged that they are used approximately in the order in which they are delivered. The stacks are to be clear of standing water and the blocks are to be protected from splashing by mud or contamination by other materials.

Blocks shall be stored either on pallets or by other methods to do approval of the Employer, in order to prevent absorption of moisture from the ground which may contain dissolved sulfates or other soluble salts.

Newly laid block work shall be protected from the harmful effects of sunshine, rain, drying, wind, running r surface water and shocks. Any work that may be damaged shall be taken out and pointed as directed by the Employer. Any costs incurred in carrying out such remedial work shall be borne by the contractor.

Testing cement hollow blocks

Concrete blocks shall be tested in accordance with SLS 522 Part 2 at the rate and for the test type given. This information shall from part of the manufacture's certificate of compliance. Where no such certificate is available then the Contractor shall carry out tests in an independent laboratory according to SLS 522 part 2.

Mortar for block work

Sand for mortar shall be naturally occurred material complying with BS 1200. It shall be stored on clean surfaces in such a manner as to allow adequate drainage, and to prevent contamination by other materials.

The Contractor shall obtain certificates of compliance with BS 1200 from the supplier and submit copies to the Employer. If requested, the Contractor shall also supply to the Employer the additional information called for in BS 1200. If certificates or control information is not available the contractor shall carry out his own regular tests to the satisfaction of the Employer.

Mortar for use with block work shall be mixed in the proportions of 1:6 cement, sand by volume. Mortar may be mixed by hand or mechanically. Hand mixing shall be carried out on a clean, watertight platform. The ingredients shall be mixed thoroughly in the required proportions, first dry and then with the addition of water until a uniform color and suitable consistency is obtained. The mortar shall be used within hour of the addition of the mixing water and any mortar not then used shall be discarded.

Plasticizers when added to mortars shall be used strictly in accordance with the manufacturer's instructions after Employers approval.

Jointing

External fair faced walls shall be weather struck: faces of walls which, are to be plastered or rendered shall have their joints raked out to form key. All other wall faces and partitions shall be flush jointed. All jointing shall be completed with pointing as the work proceeds.

7.5.7.3 Lintel

The block work over all openings in walls shall be supported on reinforced concrete lintels. All inlets shall be the same width as the block work into which they are being built.

7.5.7.4 Building in frames

Openings in masonry for doors, windows, air conditioning unit ventilators and fans etc. shall be properly marked out and built in as the work proceeds with approved anchors. The fittings shall be propped and strutted where required.

The back surface of timber fittings shall be coated with an approved timber preservative before fixing.

The back surface of steel and galvanized fittings shall be coated with a bituminous paint before fixing. All

fittings shall be bedded in 1:3 cement sand mortar 12 mm thick.

7.5.8 Roofer

7.5.8.1 General

The rate for roofing shall include the covering materials (sheets), steel or precast concrete framing. In case of steel framework, the steel purling including all trusses, beams and posts steel hips and steel valley rafters.

7.5.8.2 Roofing

Roofing shall be done using Cement tiles, Calicut tiles, Zinc-Aluminum coated profiled steel sheet or any other approved material conform to the Employer's country law and regulations. The roof shall be designed in such a way that, it has provisions to mount the PV panels on top of it. The roof shall have the relevant angle which is indicated in the PV panel manuals to gain the maximum energy.

Specifications given in ICTAD publication No: SCA/4/I&II should be followed in designing and construction of roofs.

7.5.9 Floor laying

7.5.9.1 General

All floor finishes shall be protected from damage by following trades and 'other causes and any damage, however caused, shall be made good by the Contractor at his own expense to the satisfaction of the Employer.

Floor finishes will be rejected if they prove to be defective, due to cracking, crazing, curling, uneven surfaces, or lack of adhesion. Rejected floors shall be replaced at the Contractor's expense to the satisfaction of the Employer.

7.5.9.2 Screeded beds

Concrete floors which, are required to be surface with screed shall have a roughened surface, produced by hacking and wire brushing. The roughened concrete floor shall be clean, the surplus water shall be removed and: cement/sand grout shall be brush off. The screeded bed shall be 40 mm thick and shall be well compacted and leveled with a screeding board and steel trowelled smooth. If the screed is the finished surface, it should be treated with an approved silicate of soda solution hardener to prevent dusting. The screed shall be mixed in the proportions of 1:2:4 (cement, sand, 10mm-pea shingle) by volume with the minimum quantity of water necessary to given a good hard smooth, steel trowelled finish. The section concerning concrete applies, but the sand shall satisfy the requirements of BS 1199.

Rigid screed battens shall be fixed on continuous beds of mortar to prevent movement when screed are being laid and compacted. The screed battens shall be fixed to true lines and levels.

The bay sizes shall not exceed 15 square meters and the length of any one bay shall be limited to 1.5 times the width. The bays shall be laid alternatively, i.e. in chequer board fashion, a minimum of 24 hours being allowed to elapse between the laying of adjacent bays.

The bays shall be separated by strips of hard plastic or other suitable material.

Screeded beds shall be cured for at least seven days, using polythene sheeting or other approved methods.

7.5.9.3 Damp proof course (DPC)

A damp proof course shall be laid in walls, above ground levels so as to exclude rising moisture.

Damp-proof courses shall be from one of the following materials:

(a) Lead and copper DPC complying with the requirements BS 743.

(b) Asbestos base bitumen DPC complying with the requirements of BS 743 Type C.

(c) Asbestos base lead cored bitumen DPC complying with the requirements of BS 743 Type F.

Damp-proof membrane

Approved bitumen PVC waterproof membrane shall be placed on the blinding under concrete floor slabs, to exclude rising moisture. The membrane shall be taken up walls and lapped with the wall DPC.

7.5.9.4 Indoor cable trenches

Indoor concrete lined cable trenches shall have reinforced concrete beam to support panels and with openings to pass cables.

7.5.9.5 Semi Glazed porcelain tiling

The homogeneous, full body, semi glazed, porcelain wall and floor tiles shall be used of nominal size 600x300x6mm and 600x300x6mm respectively. All tiles shall be conform to the BS EN 10545 or superior. But, due to the site condition, water absorption by mass shall be below 0.5%. For bathrooms, it shall be 0.5-3.0%. PEI wearing rating shall be class IV or above. Coefficient of friction in tiles shall be greater than 0.6. Color and fittings shall be approved by the Employer. The porcelain tile fixing and grouting materials shall be obtained from the same source. Product quality report shall be submitted for approval

The Contractor shall ensure that the rendering is accurately formed and has a true, plumb surface, which is free from all high spots and depressions.

The floated coat shall consist of a 13 mm thick rendering of 1:6 mix by volume of Sulfur resisting cement and sand: it shall be finished with a wood float. The Contractor shall ensure that the floated coat is plumb and free from all unevenness. Sufficient time for complete drying shrinkage shall be allowed to elapse between the completion of the floated coat and the start of tiling.

The work shall be properly wet out to the Employer's satisfaction. The height of tile courses shall be set out properly by means of a tiling rod; all tiles and joints shall be accurately aligned both vertically and horizontally. Joints between the tiles shall be 2 mm wide. Continuous expansion joints shall be made at all internal wall angles.

All tiles shall be dipped in water to ensure that they are completely clean prior to the application of the porcelain tile fix. All tiles shall be immersed in water in clean containers for at least half an hour before use. Tiles shall then be stacked lightly together on a clean surface to drain with the end tiles turned glaze outwards. They shall be fixed as soon as all surface water has gone -they must not be allowed to dry out more than this.

The rendering backing for tiling shall be clean and will be wetted (just enough to prevent it from absorbing water from the fixing bed) immediately prior to tiling. The tiles shall be bedded in porcelain tile fix which shall be trowelled on to the wall with a plasters trowel having 6 mm x 6 mm notches at 25 mm centers: the tiles shall be tapped or pressed into position to a true plane.

Approximately two days after the fixing of the tiles, all joints shall be pointed with neat grouting cement: the finish shall be flush and free from all voids and irregularities.

All wall faces shall be finished plumb and flush throughout, free from unevenness and irregularities of plane: all angles shall be straight and true. The finished work shall be left clean and free from all materials; cleaning down must not be carried out with materials which, will scratch or in any way impair the finished work. Final polishing shall be done with a dry cloth. The Contractor shall be responsible for the adequate protection of the tiling from all damage until the handing over. Any damage which, occur shall be made good by the Contractor at his own expense. The whole of the work shall be left in a state satisfactory to the Employer.

7.5.10 Carpentry, joinery and glazing

7.5.10.1 Timber

Timber for carpenter or jointer's work shall be hardwood of approved quality to BS 1186, Part 1 and BS 1455, the best of a species and suitable for the proposed purpose. All timber shall be subject to inspection by the Employer, piece by piece, both before and after finishing. The Contractor shall provide all necessary labor and Facilities for the inspection of timber.

7.5.10.2 Preservative

Where appropriate, timber shall be treated with an approved preservative against rot or termite attack. The backs of frames to be fixed to walls and all other bedding surfaces shall be painted two coats preservative before fixing. All fixing blocks, pallets and other hidden timber shall be so treated prior to fixing.

7.5.10.3 Workmanship

The quality of workmanship shall comply with BS 1186, Part 2. All carpenters' work shall be left "from the saw" unless otherwise described or directed. All jointer's work shall be wrought and finished with a clean, even, smooth surface.

Any carpenter's or jointer's work which shrinks, splits, fractures, parts in the joints or shows any other defect shall be removed or replaced to the satisfaction of the Employer.

3.5.10.4 Doors and windows

Fire testing doors, frames and furniture shall be of approved manufacture and satisfy the test requirements of BS 476 Part 8.

Aluminium doors shall be approved manufacturer and to be guaranteed against defects for 12 months.

Doorframes shall be framed, rebated, rounded, moulded and grooved. The frames shall be fixed in by metal anchors, secured to timber pallets, nailed to grounds, or screwed and plugged to surrounds.

Architrave's shall be moulded and shaped and shall be greater in thickness than any skirting that abuts them. They shall not be installed until after the wall coverings have been formed.

Flush doors shall be solid cored. Skeleton-framed flush doors will not be accepted but proprietary makes of cellular cored doors may be used if approved by the Employer.

Facings shall be either veneered or suitable for painting. Where hardwood veneers are used, these shall be specially selected and matched for figure of grain.

All doors shall be limped and edged with hardwood strips.

The core of solid core flush doors shall be of laminated timber strips laid alternatively with respect to grain. Alternatively, blackboard may be used. Particular attention shall be taken to select a timber for the core, which has a small ratio of movement with regard to moisture content.

Builder's ironmongery
All necessary builder's ironmongery shall be of patterns selected by the Employer from samples submitted by the Contractor. The selected items shall be provided and fixed by the Contractor in the best manner. All door fittings, locks, closures shall be accordance to EN 1670 for corrosion resistance.

Pin tumbler cylinders
Pin tumbler cylinders shall be conform to the BS EN 1303, BS 3621, BS 8621, BS 10621 and BS 12209 and of a type approved by the Employer. The cylinders shall be made of brass and chromium plated. The lock manufacturer shall supply the cylinders required to comply with the locking system referred to below and shall supply the required special keys ready for use. The Contractor shall provide three keys for each individual lock and twelve master keys. All keys shall be labeled with the room number, building code or master key number, as appropriate, and shall be handed over to the Employer on completion of each building.

Door closures
Door closures shall be of the overhead hydraulic type conform to BS EN 1155, EN1156 and EN 1158. They shall be of an approved type and provided with fine-adjusting Facilities. The size of the door closer shall be relative to the weight of the door leaf and shall be approved by the Employer.

Door fittings
All metal fittings such as hinges, locks, door handles, door bolts, etc. shall be made for heavy duty and mounted in adequate numbers. Door fittings shall be conform to BS EN 1906 and EN 1935. Samples of the selected fittings for doors shall be held by the Employer at the Site, for future comparison. Hinges shall be of steel, brass or Aluminium, with washers, selected appropriately. Where necessary, doorstoppers shall be provided.

Cylinder mortise lock and. latch sets shall be fitted to all internal doors. Lever handles shall be fitted to both sides of internal doors. Panic latch sets with external cylinder locking shall be fitted to all single external doors and to one leaf of external double doors. These locks shall incorporate a finger pull or handle externally to facilitate opening. The other leaf of external double doors shall be fitted with internal bolts.

Cylinder mortise lock and latch sets shall have a spring bolt operated by lever handles and a dead bolt operated by way.

Locking system
Door locks in the buildings on this Project shall be suited and master keyed to an overall locking system plan for doors and gates discussed and agreed with the Employer.

Keys are to be supplied according to the agreed locking system plan and handed over to the Employer against receipt only. Written notice of this shall be given to the Employer, with one copy of all key receipts.

Glazing
Glass shall be wired cast or clear sheet of thickness not less than 5 mm, free from all defects, obtained from an approved manufacturer. The Contractor shall show on his drawings the thickness of the glass proposed for the various locations. Obscured glass shall be roughcast; plain rolled or figured obscured glass.

Glazing compound for aluminum windows shall be generally of an approved polysulphide type. The glass shall be bedded against the frame on the external face with the compound and secured on the internal face with extruded aluminum bedding, screwed or clipped and studded to the frame in an approved manner so as to securely retain the glass. Glazing compound or an approved proprietary type of plastic trim shall be used where necessary to ensure a weatherproof seal.

Allowance shall be made when fixing frames for expansion of aluminum members so as to prevent distortion of frames or cracking of glass. The perimeter of the frames shall be pointed with approved mastic.

On completion of the works, broken or cracked glass shall be replaced and all glass cleaned inside and outside, to the satisfaction of the Employer.

7.5.11 Drainage, plumbing and sewage disposal

7.5.11.1 General

All pipework design, installation and testing shall be done accordance to the BS EN 806 and BS 8558. Pipe to header tank shall not be less than 25 mm bore and pipes to washbasins and WCS shall be not less than 15 more bore.

Layout of the plumbing shall be to approve standards and of the highest workmanship, with all bends to easy sweeps and bores and thickness maintained throughout.

Internal plumbing system shall be connected either to public water system well or tube well as instructed by the Employer.

All drainage design, materials and workmanship shall be in accordance with approved standards and Codes of Practice.

All drains shall be laid in straight lines and regular gradients as described or directed. Great care shall be exercised in setting out and determining the level of the drains! All drains shall be .kept clear from earth, debris, superfluous cement and other obstructions during and after lying. All drains shall be provided with eyes, inspection covers, etc. to ensure that every length can be prodded effectively in the event of a blockage.

7.5.11.2 Drain pipes

Drainpipes shall be PVC pipes and fittings of approved manufacture and shall be jointed with sleeves or sockets. PVC pipes provided should be black unplasticized PVC complying with BS 4660 or 5481, or equivalent standard.

Concrete beds and casings to drain pipes under roads shall be of week concrete and of 150 mm minimum thickness. Elsewhere the pipes and ducts shall be laid on and surrounded with approved granular material.

7.5.11.3 Manholes

Manholes shall be generally in accordance with BS 8301. Galvanized malleable cast iron step irons are to be provided and built in as work proceeds.

Manhole covers shall comply with BS 497 and in roadways or heavily loaded areas shall be heavy duty. ln pedestrian areas or areas with non-vehicular access to be medium duty.

7.5.11.4 Septic tank

The septic tank, where main drainage is not available, shall be constructed in an agreed position at least 20 meters from any building. The design shall be to recognized standards such as BS 6297 and approved by the Employer. The tank shall have separate fresh air inlet and outlet pipes and be provided with access openings. The effluent from the tank shall discharge, depending on the type of subsoil, to a soakaway pit or either through evapor transpiration beds or upflow filter, a soakaway pit shall be covered by a concrete slab, with access through a manhole cover.

In impermeable type soil, where a soakaway will not function efficiently, either evapor transpiration beds or unflow tilter shall be provided, for effluent disposal from the tank.

The system shall be properly ventilated by continuing the soil pipe above the highest branch upwards above roof level.

7.5.11.5 Water pipes

PVC pipes shall generally be used throughout of an approved type. They shall be secured to the structure. Pipes to wash hand basins and WC cisterns shall be 15 mm bore and supply pipes to header tanks 25 mm bore.
Plastic piping and fittings shall be permitted where adequately protected or where risk of impact is small.
Overflow pipes shall be taken from the tops of cisterns and set to discharge in a prominent position.

7.5.11.6 Sanitary fittings

Sanitary fittings shall be conform to BS 6465

Wash hand basins shall be pedestal type and screwed to the walls using brackets. They shall be provided with 35 mm bottle traps with brass cleaning eye and lining soldered on, or alternatively, similar PVC fittings.

Cistern supporting brackets shall be screwed to 30 mm timber chambered backboards which, shall be plugged and screwed to the walls. Overflow pipes from WC cisterns shall be 20 mm bore
.
Glazed ware shall be of best quality types and manufacturer shall be approved by the Employer. Fittings shall be securely fixed in an approved manner.

7.5.11.7 Taps and fittings

Applicable British standards shall be followed in selecting taps, showers and other fittings

Taps and all visible metal fittings shall be either chromium plated or plastic, heavy-duty best quality approved by the Employer.

Wash down type water closed. (low level) Suit with vitreous China comprising closed with P or S trap with flushing cistern 9 liters capacity supporting brackets, connection all complete to working order.

On completion of the works, all sanitary fittings shall be left in a clean and proper condition.

7.5.12 Painting and decoration

7.5.12.1 General

All work shall be properly cleaned and rubbed down between each coat in a way, and using materials, recommended by the manufacturers of the paint concerned. No coat shall be commenced until the Employer has passed the previous coat as dry, hard and satisfactory.

Each coat shall be of the distinct color from the proceeding one and all colors shall be approve by the Employer. All paint shall be applied in accordance with the maker's recommendations and shall not contain more than a minimum quantity of thinners or disperses necessary to permit the satisfactory application of the paint. Spray painting will not be permitted except for internal faces of walls and ceiling. All other paint shall be thoroughly brushed into and completely cover the surface. Ironmongery shall be removed before painting and refixed when the paint is dry.

At the completion of all works, the Contractor shall clean down the premises; wash paving and steps; wash and leather down wall tiling, etc., clean all sanitary fittings; touch up paint work; examine all roofs and leave watertight; clean out all pipes and leave the whole of the premises in a clean, sound and perfect condition ready for immediate occupation.

7.5.12.2 Paints and other materials

Paints for priming, undercoating and finishing shall be ready mixed paints of the best quality for the intended use and comply with BS 6150. All paints shall be obtained from an approved manufacturer who shall certify that the paint is suitable for the intended purpose. Paint for use on concrete or block work shall be of a type specially prepared for this purpose. Linseed oil should be best quality refined raw or boiled linseed oil. Turpentine shall be best quality. No substitutes shall be used unless approved by the Employer. Knotting shall be of the best quality to BS 1336, consisting of shellac dissolved in methylated spirits, and shall be free from resign and naphtha. Stopping shall be hard patent white lead stopping, composed of one part white lead and two parts linseed oil putty with the addition of a small quantity of gold size.

7.5.12.3 Woodwork

All timber required to be built into, bedded or fixed against brickwork; masonry or concrete shall be given two priming coats and one under coat on the concealed surfaces.

All woodwork shall have knots treated with two coats of a knotting solution and then painted with aluminum priming paint prior to priming the complete surface. The wood shall then be primed, stopped and painted with two undercoats and one high gloss-finishing coat.

Hard wood which, is not required to be painted shall be made perfectly smooth, prepared and oiled twice with linseed oil. Alternatively, it shall be stained and wax polished, or treated with two coats of an approved varnish.

7.5.12.4 Iron and steel works (except structural steelworks)

All surfaces shall be dry and thoroughly cleaned of all loose scale, rust and grease before painting is commenced.

Iron and steelworks which is to be built into or against block work, masonry or concrete shall be painted with two coats of black Bitumastic paint.

All other iron or steelworks, except galvanized metal, shall be painted with two priming coats, two undercoats and one finishing coat. One coat of primer shall normally be applied at the manufacturer's works.

Galvanized metal which, is to be painted shall be treated with mordant. Solution and primed with one coat calcium plumbate primer, followed by one undercoat and one finishing coat of oleo-resinous paint.

7.5.12.5 Bitumastic painted surfaces and coated pipes

Bitumastic painted surfaces and coated pipes shall be thoroughly cleaned to remove grease, dirt or there deleterious matter, and then painted with one coat of sealer, one coat of leafing aluminium, one coat of undercoating paint and one coat of high gloss finish.

7.5.12.6 Cement, block work and plaster

When so described or directed internal surfaces of fair-faced block plastered wall shall be prepared and painted with one coat of anti-suction primer, followed by one undercoat and one finishing coat of PVA based plastic emulsion paint.

Exterior surfaces of fair faced block work walls and concrete columns at the buildings shall be prepared and painted with two coats of an approved stone paint.

All paint shall be of an approved type and suitable for its required purpose, with surface preparation and paint application being strictly in accordance with the manufacturers' instructions.

7.5.13 Cable ducts
7.5.13.1 General

All cable ducts shall be laid in straight lines and regular gradients between cable pits, as directed. All ducts shall be kept clear from earth, debris and other obstructions during and after lying.

7.5.13.2 Ducts

Cable ducts may be pitch fiber, PVC, plastic or other material approved by the Employer and obtained from an approved manufacturer.
After the cable ducts have been completed, a cleaning rod shall be drawn through each duct and a No. 8 gauge galvanized iron-fishing wire drawn in after the rod. The ends of the ducts shall be plugged with a wooden plug and the fishing-wires left in the ducts.

7.5.13.3 Concrete beds and casings

Concrete beds and casings to cable ducts and under roads, buildings, floors and foundations shall be of lean concrete and of 150 mm minimum thickness. Elsewhere the ducts shall be laid on and surrounded with approved granular material of 150 mm minimum bed thickness and 300 mm minimum cover.

7.5.13.4 Cable pits

Cable pits shall be provided at interval not exceeding 100 meters and also at the bends of all cable ducts.

Cable pits may be constructed of bricks; concrete blocks, in-situ concrete or precast concrete chamber rings and cover slabs. In each case, the material shall be in accordance with the relevant sections of this Specification. Cable pits shall be sized according to their depth, to provide sufficient working space and access for maintenance. When constructed of block work, they shall be rendered internally with sand/cement mortar finished with smooth vertical surfaces.

Where precast concrete rings are used they shall be surrounded with concrete 150 mm thick.
Galvanized malleable iron steps are to be provided in all cable pits over one meter deep and built in as work proceeds.

7.5.14 Perimeter security fencing and gates

7.5.14.1 Security fencing

Overall height of the fencing shall be 2.4 meters above ground level, excluding barbed wire. A further 100 mm depth shall be buried in the ground, but where conditions prevent this, the bottom of the fence shall be fixed down with staples to a continuous concrete sill, or to rocky ground, in accordance with BS 1722, Part 10.

PVC coated wire for mesh and line wire shall comply with BS EN 10245. All mesh shall be of PVC coated wire of 3.55 mm dia., with a length of side not exceeding 50 mm. Line wires shall be of PVC coated wire of the same gauge to adequately support the mesh rigidly. Line wire shall be provided at the top and bottom of the mesh and at two evenly spaced intermediate levels. The line wires shall be strained tightly by eyebolt strainers or winders at each straining post and secured to intermediate posts of stirrup wires passed through holes in the posts. The top wire shall be doubled, making five line wires in all. Mesh and line wires shall comply with BS 4102. PVC coated Chain link mesh shall be strained between straining posts by means of stretcher bars and tied to line wires in accordance with Clause 3.5 of BS 1722, Part 10.

Straining posts and struts shall be of Galvanized steel to the same standard as above. The minimum thickness of posts, shall be 4mm for tubular sections and 5mm for other sections. The posts shall be set in concrete in the ground. The posts shall have cranked tops set at 45° to the posts, to which shall

be attached three strands of galvanized barbed wire to BS EN 10245. Barbed wires shall be strained between straining posts with eyebolts and fixed to intermediate posts with stirrup wires. Droppers shall be fitted at the center of each Bay of the fence to prevent the wires being bunched together. Intermediate posts shall be provided at centers not exceeding 3 meters. Corner posts and struts shall be provided at all ends, corners, changes in direction, adjacent to gate posts and at intervals not exceeding 35 meters. All fence fittings shall be PVC coated or galvanized with references to a standard.

7.5.14.2 Gates

Gates shall comply with BS 1722, Part 10 and shall be constructed of galvanized chain link mesh on a galvanized RHS or tubular steel frame with three strands of barbed wire across the top on galvanized extension arms.

The gates shall be fitted with a vertical drop bolt on each leaf, a sliding bar lock with padlock eyes and a padlock to prevent movement of the sliding bar lock.

The padlocks shall be included in the overall locking system plan referred to in Clause 1.13.13. All these fittings shall be galvanized. The vertical drop bolts are to drop into galvanized steel tubes cast into the road, to secure the gates when in both closed and open positions.

Gateposts shall be made from galvanized steel RHS or tubular section shall be capped and set in concrete in the ground. Gate hinges (pivots) shall be heavily galvanized They shall comply with Clauses 2.8.5 and 2.8.6 of BS 1722, Part 10, or other approved details and should be fixed with turn buckles to the gate posts to avoid any lowering of the gate leaves.

The hanging and shutting stiles of each gate leaf shall be extended vertically upwards for the support of three strands of barbed wire, all as required by BS 1722, Part 10.

7.5.14.3 Galvanized barbed wire

PVC coated barbed wire shall conform to BS EN 10245 or similar approved material.

7.5.15 Ceilings

7.5.15.1 Horizontal & Inclined suspended ceilings

Horizontal & inclined suspended ceilings as required shall generally be of approved mineral fiber incombustible panels of an exposed T grid. The design, materials, installation shall conform to BS EN 13964. The boards shall be of self-finished type. The ceilings shall be accurately aligned to the levels shown on approved drawings.

The exposed T grid shall be adequately supported from the roof, on adjustable straps and rod hangers as required.

At perimeter walls and columns the grid shall be neatly trimmed with angle trimmers.

If required air-conditioning grilles shall be incorporated in the ceiling grid system. These shall be neatly formed and edged in material matching the grid.

The ceiling or roof slab shall be insulated to achieve the U-values specified. Insulation materials and methods of fixings shall be submitted to the Employer for approval.

The Bidder shall specify the type and manufacturer of his proposals for the above ceilings, in the Schedule included in the document.

Samples of materials shall be submitted to the Employer for approval before ordering.

7.5.16 Wall and ceiling finishes

7.5.16.1 Generally

All internal plastering shall be carried out in accordance with BS 5492 and external rendering with BS 5262.

All proprietary brands of plaster or rendering materials shall be selected and applied strictly in accordance with the manufacturer's instructions regarding the different purposes and backgrounds for which they are intended. Particular attention shall be paid to the manufacturer's instructions regarding the time allowed to elapse between mixing and using.

The plastering shall be carried out by persons experienced in this type of work and the whole of the work shall be finished to a true and even surface, free from all defects. Any cracks or other defects shall be cut out and made good.

7.5.16.2 Workmanship

Backgrounds for plaster work or rendering shall be prepared by carefully brushing to remove dust and other adherent particles of any other material likely to impair the bond of the undercoat with the structure. If undue suction occurs on the background surface, this shall be sprinkled with water to prevent drying the applied plaster.

Joints of block work, which is to be plastered or rendered, shall be raked out to a depth of 13 mm.

Joints shall be introduced in plastered and rendered surfaces over all movement joints.

Such joints shall be formed by inserting casing beds, plaster stops, etc., arranged one on each side of the joint, with the gap between them filled with a suitable mastic sealing material and covered with a metal astral strip.

Plaster/render stops and angle beads shall be expanded metal and provided at corners, movement joints doorways, lower edge of rendering etc., all in accordance with the manufacturer's instructions.

7.5.16.3 Materials

Cement, sand, gypsum plaster, galvanized expanded metal lathing, flat headed galvanized nails, galvanized staples and wires shall all comply with relevant British Standards and approved standards. Materials shall be carefully stored in a dry weatherproof store until required for use.

Interaction of materials

ln no circumstances shall cement be used in the same mix as gypsum plaster, nor shall the two materials be allowed to contaminate each other. Any materials inadvertently contaminated shall be rejected from the site.

7.5.16.4 Plaster work

Care shall be taken in the selection of the type and strength of plaster mixes, to ensure that undercoats and finishing coats are compatible with each other and with the background, in order that bond failure, shrinkage and thermal cracking, etc. are minimized. Mixes may be based on cement or on gypsum. The first undercoat shall not be stronger than the background and each subsequent coat shall to be stronger than the previous coat. The total thickness of plaster work shall not be less than 15 mm.

Cement -based undercoats shall consist of Sulfur resisting cement, and sand to BS 1199, gauged in the proportions 1:5. The undercoats shall be keyed to take the subsequent coat and allowed to dry out completely before the latter is applied, but rapid drying must be avoided.

Finishing coats for use on cement-based undercoats shall be the same mix proportions as the undercoats and shall be finished to a smooth, true and even surface.

Gypsum based undercoats shall use retarded semi-hydrate gypsum plaster to BS 1191, Part 1, Class B, mixed in accordance with the manufacturer's instructions. Each undercoat shall be 6 mm thick. The second under coat shall be applied immediately the first coat has hardened and will produce adequate suction.

Gypsum finishing coats shall be gypsum to BS 1191, Part 1, Class B, mixed with clean water and used neat or mixed with up to 1/4 part lime and 1 part sand, all in strict accordance with the manufacturer's instructions, to thickness of 4 mm.

Other plaster mixes will be considered by the Employer, but must be confirmed by the manufacturer as suitable for the background intended.

7.5.16.5 External rendering

Where walls are to be rendered externally, the concrete frame shall be proud of the block work panel walls.

External rendering shall be applied in two coats, with an approved waterproof agent added to the mixes. The walls shall be wetted before the application of the first coat, which shall be finished flat and vertical by straightedge, and scored to form a key. The second coat shall not be applied until the first coat has dried out completely. Immediately before application of the second coat, the surface of the first coat shall be wetted, and the second coat shall be applied by an approved method, to give a textured finish of uniform thickness. An approved plasticizer may be used in both coats. All external rendering shall be protected from rain and direct sunlight for a period of 7 days.

Where backgrounds for plastering or rendering are different material, the joint between them shall be covered where necessary with a strip of building paper under expanded metal lathing, overlapping the joint by a minimum of 150 mm. Where the lathing crosses concrete columns between block work panels, the complete column widths should be bridged by the building paper under the lathing, which should then be fixed to the block work only, on each side of the columns. Expanded metal lathing shall be cut, fixed and jointed in accordance with the manufacturers' instructions. Fixing shall be generally at intervals not exceeding 300 mm. Sheets of lathing shall overlap at least 25 mm at side and ends and wired together at 100 mm intervals, using galvanized wire. After fixing, all cut edges and damaged nail heads etc. shall be painted with bitumen oil paint.

3.5.16.6 PVC Flooring

PVC flooring shall be flexible PVC tiles obtained from approved manufactures. The tile shall be 2 mm thick laid to the approval of the Employer.

Acid resistant non-slip floor tiles of size 300 mm x 300 mm with 100 mm skirting to Battery room. Semi glazed homogeneous full body porcelain wall tiles including bedding grouting cutting and waste.

7.6 Lighting and Small Power Supply Work

7.6.1 Project Requirement

This section of the specification includes for the lighting and small power installation and emergency lighting.

All civil works associated with this section of the works shall be deemed to be included either as part of the main civil engineering works or as part the works in this section. No additional payments will be made for such requirement.

The requirements of this section of the works are subjected to the conditions and specifications laid down in other sections and volumes of the Tender Documents.

7.6.2 General Standards

The completed installations shall comply in all relevant respects with the Regulations issued by the Institutions of Electrical Employers (IEE) with the Codes of practice issued by the chartered institutions of Building Services, or International Electrical Committees Standards, or with such other regulation that may be in force in Sri Lanka.

7.6.3 Maintenance

The Contractor shall be responsible for maintenance of the installations comprising this section of the Specification for the agreed period as set out in this Specification document.

7.6.4 Approvals

The Contractor shall submit to the Employer for approval copies of all his calculations forming the basis for the designs of the lighting and small power installation which shall be shown on the working drawings, also to be submitted for approval.

Any approval shall not, however, relieve the Contractor of his contractual responsibilities.

7.6.5 Price Schedule

The Contractor shall enter into the schedules, a fixed sum for the complete works under this section of the Specification and no price variation will be considered.

7.6.6 Requirements

The lighting installations shall be designed to give the standard service illuminations set out in the schedule appended to this section. Control Room, Generator Room, batter babk & inverter room shall have the service illumination measured at 850 mm above finished floor level. All other areas shall have the service illumination measured at floor level.

The installations shall also meet the limiting glare index requirements as set out in the specified codes of practice. The schedule gives proposals for the types of lighting fittings to be used in the area, type of control to be employed, number of socket outlets and the types of mounting expected to be suitable for the respective areas. When 3 phase lighting installations are to be used, contractor switching controlled by push buttons located in the areas to be illuminated are preferred.

Emergency lighting shall be arranged to illuminate all stain/vays, exits and entrance and provide some illumination in operational areas.

Schedule of design requirements

Key to Abbreviations

L	Single pole local switches
S1, S2, etc.	Socket outlet or fused spur circuits
PB	Push - button for remote control

TS	Time switch control
C	Ceiling mounted
W	Wall mounted
P	Pole or earth mast mounted
M	Recessed modular mounting
D	Suspended
F	Flush installation
S	Surface installation
A	Automatic on mains failure
PEC	Photo-Electric cell control
MAN	Manual control

7.6.7 Coding System

The Contractor shall when preparing drawings showing the respective designs use a code to identify each lighting fittings and socket outlet. ,

The code shall comprise letters and figures so complied that the following information can be readily identified;

(a) The lighting distribution board to which the fittings or socket outlet is connected.

(b) If connected to the normal supplies or to the emergency DC supplies

(c) The circuit numbers and phase of the distribution board to which the fitting is connected.

(d) The sequence of the fitting in a particular circuit

7.6.8 AC Distribution Boards

Distribution board for substation supplies shall be of the single bus bar, air insulated multi-cubicle or multi-box factory built assembly type, incorporating air break, manually operated MCCB units, suitable for installation in the substation building on a 400-230 V, three-phase, four wire, 50 Hz system, having the neutral earthed through earthing transformer.

Unless otherwise specified, distribution boards shall be in accordance with lEC 60439, lEC 60408 or BS 5486 Part 1 and Part 2 and to BS 5419 and the degree of protection shall be not less than IP 41 to BS 5240 or better equivalent of the concerned standards.

Incoming supplies to all distribution boards shall be protected at the point of supply by MCCB. All distribution boards should be suitably rated for a prospective short circuit breaking capacity of 25 KA at 600 V.

Distribution boards shall each include three-phase busbars, one neutral busbars and an earthbar; all of high conductivity copper supported to withstand the normal and fault condition stresses.

The neutral busbars shall have a rating not less than 50% of that of the associated phase busbars. Distribution boards shall have a busbar rating not less than 100 Amperes.

Each Distribution board shall consist of a fabricated steel busbar chamber having MCCB, in distribution boards and attached and mounted at a height convenient for the operator. The distribution board shall be of type, which is readily extensible and suitable for use in a hot humid climate each circuit shall be clearly labeled to show the destination of the associated cable, the "ON" and "OFF" positions of the switches being clearly indicated.

Cubicle type (metal-enclosed type) distribution boards shall be so arranged that cubicles housing individual control units are grouped to form a multi-tier arrangement and a further part shall where possible constitute a cabling and wiring chamber of ample dimensions in which terminal boards, cable boxes and cable seal plates shall be located.

The distribution boards shall be finished to the approval of the Employer and painted Munsell Color 5Y7/1.

Each MCCB unit shall be mounted on a metal panel and provided with a hinged metal door and key locked.

The MCCB shall have a quick make and quick break action independent of the speed at which the switch handle is operated and shall be entirely suitable for switching the inductive loads associated with motor circuits.

Fuses shall be of the HRC cartridge type for operation at a prospective fault level of 25 kA and conforming to BS 88, where applicable. The mountings of the fuses shall be such that they can be readily withdrawn and replaced whilst the associated busbars and circuits are live.

Incoming circuits at distribution boards shall not be provided with fuses for prevention of lack of phase.

MCCBS shall be of the high speed fault limiting, thermal/magnetic type to IEC, or BS 3871 or equivalent standard, with quick make and quick break trip free mechanisms which prevent the breaker being held in against overloads or faults.

Tripping arrangements shall be such as to ensure simultaneous opening of all phases. Arc extinction shall be by de-ionizing arc chutes.

MCCBS on the incoming circuits shall have Facilities for locking in the "off" position.

The rupturing capacity of the MCCB shall not be less than of the switchboard itself.

ACBs or MCCBS shall be provided on the incoming circuits at the respective station Services, main distribution boards. These circuit breakers shall be equipped with thermal device shall have an adjustable IDMT characteristic and the magnetic device an adjustable short time delay.

Earth metal of distribution boards shall be bonded and earthed to the main station earthing system.

Approved MCCB or title labels shall be fitted externally on the front cover each switch or distribution board giving the function of each circuit. A non- fading printed list of circuit shall be provided on each sub distribution boards, stating the location of the equipment served, rating of the protective unit and the circuit loading. The lists shall be mounted on the inside of the cover door and shall be protected by an acrylic sheet slid in to a frame over the circuit list, the list and cover to be easily removable to permit circuit modifications.

The distribution boards for building services shall be manufactured and tested in accordance with the latest standard and be capable of withstanding without injury the mechanical and electrical stresses set up by a fault equivalent to 25 kA at 600V for twice the period required to disconnect such on any circuit.

Each distribution board shall have a dust proof metal case of sheet steel with either a galvanized or enameled finish to IP 41. The color of the enamel finish shall match the color of other switchgear. The metal casing shall be provided with a number of knock-outs or other approval form of cable entries corresponding to the circuit capacity of the distribution board and a suitable earth busbar. Distribution boards shall also meet the requirements of the appropriate sections of this clause.

Distribution boards for exterior use shall be galvanized and weatherproof to lP 54.

Distribution boards for use on direct current system shall be double pole types equipped with adequately rated fuses.

Mixed capacity board shall be employed and all contactors and control switches associated with the respective outgoing circuit shall be accommodated within the distribution boards.

7.6.9 Cables

Cables designated PVC shall be polyvinyl insulated or polyvinyl insulated and sheathed types manufactured and tested to the requirements of BS 6004, 600/1 OOOV grade or equivalent. Sheathed types shall be equipped with an earth continuity conductor.

Cables designated XLPE shall be cross-linked polyethylene insulated filled and polyethylene sheathed of polyvinyl chloride sheathed overall and be manufactured and tested in accordance with requirements of BS 6364,600/1000V grade or equivalent. The outer sheath to be colored black. Jute fillings will not be permitted.

Flexible type cable for pendant cords and final connections to fixed apparatus shall be butyl or silicone rubber insulated and sheathed manufactured and tested in accordance with the requirements or BS 6500,300/500V or 300/300V grade as applicable.

The conductor shall comprise multi-strand of 0.25 mm or more. The number of strands shall be not less than 30 and in all cases of number suitable for the protection rating of the respective circuits.

All cables used for lighting and small power shall have copper conductors.

The Contractor shall select conductor sizes for the respective final circuits to meet the following conditions;

(1) That the minimum conductor size for lighting circuit shall be 1.5 sq.mm and for socket outlets 2.5 mm.2

(2) That the size shall be adequate for the current to be carried as set out in the cable manufactures specification.

That the size is sufficient to keep the voltage drop in the phase and neutral conductors to the farthest lighting or power point, under normal full load conditions, to within the final circuit limit specified in the IEE Wiring Regulations. Diversity will not be allowed.

7.6.10 Cable Termination

Termination's for cables shall comprise compression type clamps and bonding clamps to meet the requirement of BS 6121 or equivalent and shall be designed to secure and to provide electrical continuity between the conductor and the threaded fixing component of the clamps.

Earth bond terminal attachments shall be provides.

Termination for PVC insulated and rubber insulated cables shall comprise compression type clamps as specified for the terminations for XLPE cables mentioned above.

7.6.11 Contractors

Contractors shall company with BS 5454, IEC 518/1 A or equivalent and shall be of the electrically held-in types contained in heavy gauge sheet steel case suitable for panel mounting. Each contactor shall be continuously rated and suitable for thirty inductive switching operations per hour and a utilization category of AC2.

7.6.12 Switches and Push-Buttons

Switches shall be rated for 16 or 20 amps. And shall be single pole types and be provided with an earth terminal.

Switches use in areas for surface installation shall be quick-make-quick-break fixed grid industrial types mounted in galvanized malleable iron boxes with protected dolly and arranged where necessary for multigang switching.

Switches for use in areas designated for flush installation shall be micro- break types fixed to white plastic cover plates and mounted in galvanized steel flush type boxes.

Two way and multigang variations shall be provided as appropriate.

Push - button switches shall either be flush or surface types contained in galvanized steel boxes and are single pole rated for 5 Amps. Or more _ push buttons shall be made of non-hygroscopic material, be non -swelling and so fitted as to avoid possibility of sticking

The terminals for all switches shall be adequate to accommodate 2 conductors each 1.5 sq.mm in area.

7.6.13 Lighting Fittings

Illustrations and/or samples of all lighting fittings, which the Contractor proposes to purchase, shall be submitted to the Employer for approval before issuing any sub-orders.

Lighting fittings for interior and exterior use shall be manufactured and tested in accordance with the appropriate sections of BS 4533 or equivalent and together with all components shall be suitable for service and operation in the climate stated

Each fitting shall be complete with all lamp holders, control gear, internal wiring, fuses and terminal block. Earth terminal and reflectors or diffusers as specified. The design of each fitting shall be such as to minimize the effect of glare and such that the ingress of dust, flies and insects is prevented. Where open type fittings are used it shall be impossible for insects to become lodged therein.

The control gear for use with fluorescent lamps shall incorporate power factor and interference suppression capacitors. Chokes shall be impregnated and solidly filled with polyester resin or other approved high melting compound and shall be manufactured to restrict the third harmonic content to less than 25% of the uncorrected current value and shall be silent in operation.

Control gear for discharge lamps shall incorporate power factor and interference suppression capacitors.

Internal connections shall comprise stranded conductors not less than 0.75 sq.mm covered with heat resistant insulation to the requirements of BS 6500 or equivalent. All internal wiring shall be adequately cleat to the fitting casing with an approved form cleat. The finish of fittings for interior use shall be impervious, to deterioration by atmospheric reaction. Fittings for exterior use shall have a vitreous enamel, natural aluminum of galvanized finish according to the manufacture's standard product.

Fitting or housing tungsten lamps exceeding 150 watts rating shall be provided with an approved method of dissipating heat from the lamp cap and terminal housing.

Lamp holders as applicable shall be suitable for the lamp specified,

Flood lighting fittings suitable for 160W low pressure Sodium Vapor lamps are preferred.

Lighting fittings shall be of the type description as generally set out in the schedule appended to this Section of the Specification. The type references used shall be repeated in the Schedule and on the drawings.

7.6.14 Lamps

The Contract includes the supply and erection of all lamps and tubes necessary to compete the installation and these shall be included in the prices quoted for the supply and erection of fittings.

Fluorescent lamps shall be manufactured and tested in accordance with British Standards 1853, IEC 81 equivalent shall be bi-pin types and shall be warm white colour.

7.6.15 Socket Outlets and Fused Spur Outlets

The Contract shall include suitably located; heavy duty, weatherproof three phase and neutral interlocked switched socket outlets and plugs for supplying the transformer oil filtration units. Ample single phase outlets shall be located in convenient positions, and at least one three phase and neutral, light duty outlet with plug shall be located in each room.

Each socket outlet shall comply with the requirements of the British Standard 1363 or equivalent and shall be the interlocked shuttered and switched types arranged for surface or flush mounting in single or multigang units as appropriate.

Each fused spur outlet shall be equipped with double pole isolator, a fuse to British Standard 1362 or equivalent and where required front entry for flexible connection.

Each socket outlet and fused spur outlet shall be provided with a galvanized metal box with earth terminal.

Each group of five socket outlets shall be provided with matching fused plug top.

All socket outlets for exterior use shall be galvanized and weatherproof and be equipped with screwed dustproof attached to the socket by means of chain.

7.6.16 Conduit and Fittings

Conduit fittings of PVC shall be of the plain bore pattern suitable for a push-on compression type joint and shall be sealed with a hard setting vinyl cement to prevent ingress of vermin, water, dust, etc.

7.6.17 Interior Installations

Wiring for the lighting and socket outlet installation shall comprise PVC cables drawn into conduits attached to walls, structural or roof steelwork or ceilings as appropriate.

All fixing shall be of a type approved by the Employer and all metal work used shall be galvanized. Fixings to structural steelwork shall be with purpose made brackets or clamps, the drilling of structural steelwork will not be permitted.

Cleats with two screw fixings shall be used for supporting conduits at not greater than 2-m intervals.

All switch boxes, socket outlet boxes and items of a similar type shall be fixed with two screws or bolts, Switches and push buttons for lighting circuits shall be mounted at 1,300mm above finished floor level. Socket outlets shall be mounted 500 mm above finished floor level but those for use with workshop benches shall be mounted 150 mm clear of the bench working surface.

Lighting fittings shall be attached to ceiling, walls, trunking of roof steelwork or suspended there from as appropriate. Where fittings are to be suspended, rod type suspension units shall be employed.

Final connections to all suspended lighting fittings shall be with heat resistant flexible cable terminated in porcelain clad connectors in the ceiling or junction box which shall also terminate the main circuit cable. The cable length shall be such that the suspension unit supports the full weight of the lighting fittings.

Where recessed type lighting fittings are to be installed suspension units shall be used to prevent the weight of the fittings being applied to the suspended ceiling. It shall be possible to carry out maintenance from the underside of the fitting without disturbing the false ceiling.

To facilitate this needed the final connection to each fitting shall be with heat resistant flexible cable from a plug in type ceiling rose mounted above the false ceiling.

Where lighting fittings are mounted direct on walls or ceilings the main circuit cables may be connected into the fitting terminal block and where the fittings are mounted flush with the ceiling the final connection shall be taken through ceiling roses. Where terminal blocks do not exist within the lighting fitting flexible heat resistant cable shall be used connected to a separate junction box.

Earth continuity shall be maintained throughout the entire wiring installation with separate insulated earth continuity conductors of adequate cross-section ultimately connected to a common earth terminal at the respective distribution board.

Each and every trunking route shall be bonded across all joints with external copper bonding links supplied for the purpose.

7.6.18 Exterior Installation

Transformer floodlighting preferably be mounted R.C.Poles at the high 6.0 m above the ground level, floodlighting for Line Gantry shall be mounted on the Gantry structure of the height of 11.0 m above the ground level.

A suitable access ladders shall be provided on the masts for maintenance of the lighting fittings. Where this not feasible the floodlight fittings shall be mounted on poles also at a height of 8.3 meters above ground.

Roadway lighting shall comprise roadway lanterns mounted on poles at 6.0 meters above the finished road level. All exterior lighting shall be controlled by photoelectric cell.

Cables to exterior lighting shall be XLPE cables laid in concrete trenches or cleated to building structures or into steel conduits galvanized as appropriate to the route requirement. The cables shall be terminated at a cut-out located at the base of each support. Wiring between the cut-out and the control gear or lantern shall be with PVC or PE multi-core cables run within poles or drawn into galvanized steel conduit attached to the supporting structure. Switching arrangement for exterior lighting system shall be located in the control building.

7.6.19 Earthing and Bonding

All equipment being supplied under this section shall be effectively bonded to ensure earth continuity throughout the Plant. Continuity may be provided by means of steel conduits but a separate earth continuity conductor shall be included with all wiring in conduits. No reliance shall be placed on metal to metal joints in conduits for each continuity. The earth continuity conductors shall as far as possible is in one continuous length to the furthest part of the installation from the controlling switchboard. The earth conductor shall connect all metal cases housing electrical equipment.

The branches shall be connected to the main conductor by permanent exothermic fusion welded joints or crimped joints approved by the Employer.

7.6.20 Schedule of Lighting Fittings and Socket Outlet

Lighting fittings described in this Schedule shall also meet the general requirements of clause 15.16 of this Specification.

TYPE F 1 Shall indicate a basic channel complete with control gear and lamp holders for one 40-watt fluorescent lamp, equipped with open-ended metal reflector having upward light slots.

TYPE F 2 Shall indicate a fitting, which shall comply generally with the description for Type F 1 but be equipped for use with two 40 watt lamps.

TYPE F 3 Shall indicate a basic channel complete with control gear and lamp holder for one 40 watt fluorescent lamp, equipped with an opal sided diffuser having clear reeded bottom.

TYPE F 4 Shall indicate a fitting, which shall comply generally with the description for Type F3 but be equipped or use with two 40 watt lamps.

TYPE F 5Shall indicate a dust-tight weatherproof and vapour resistant fitting, having a Gray polyester fibber glass reinforced chassis containing the control gear and having lamp holders for one 40 watt fluorescent lamp. The fitting shall be complete with a vacuum formed arcylic diffuser which is secured to the body with injection moulded toggles and sealed with a neoprene gasket.

TYPE F 6Shall indicate a recessed modular fitting suitable for mounting in a suspended ceiling and equipped with an aluminium louver with matt mirrors. The material of tixture shall be coated steel. The fitting is to be equipped with a pre-wired removable gear tray and adjusting Facilities to enable levelling relative to the ceiling to be carried out after erection. The assembly is to be complete with control gear and lamp holders for one 40 watt fluorescent lamp.

TYPE F 7 Shall indicate a fitting, which shall company generally with the description for Type F6 but be equipped for use with two 40 watt lamps.

TYPE F 8 Shall indicate a surface mounted fitting suitable for mounting in a suspended ceiling and equipped with an Aluminium louver with matt mirrors. The materials of fixture shall be coated steel. The fitting is to be equipped with a pre-wired removable gear tray. The assembly is to be complete with control gear and lamp holders for one 40 watt fluorescent lamp.

TYPE F 9 Shall indicate a fitting, which shall comply generally with the description for Type F8 but be equipped for use with two 40 watt lamps.

TYPE E 1 Shall indicated a vitreous enamelled or spun aluminium over-lamp dispersive type reflector with cover glass, cool wiring box and lamp holder all suitable for use with 60 watt tungsten lamp. Finished colour gray outside and white inside.

TYPE E 2 Shall indicate non-sustained emergency lighting unit comprising an enamel metal base with flame retardant PVC mounted body equipped with white opalescent styrene moulded diffuser with the word "EXIT" in English added to the face in green characters.

TYPE E 3 Shall indicate a square shaped all insulated dust tight weatherproof fitting constructed of moulded polypropylene suitable for use with a 60watt tungsten lamp.

TYPE E 4 Shall indicate a semi-recessed fitting housing a 100 watt lamp and equipped with crystallite glass diffuser.

TYPE S 1 Shall indicate 13 Amps one gang flush mounted switched socked outlet.

TYPE S 2 Shall indicate a 13 Amps one gang surface mounted switched socked outlet.

TYPE S 3 Shall indicate a bench mounted 4 gang unit of 13 Amps switched socket outlets.

TYPE S 5 Shall indicate a one gang 13 Amps fused spur unit.

TYPE T 1 Shall indicate a bulkhead type fitting having a body cast from corrosion resistant aluminium alloy with light control by means of a prismatic glass held firmly in position in a hinged glazing ring, complete with lamp holder for 100 watt lamp, terminal block suitable for looping conductors and provision for cable entries. Mounting lugs are to be arranged such that fixing screws do not penetrate the fitting interior.

TYPE T 2Shall indicate a light fitting having a body and diffuser of polycarbonate, complete with internal reflector and porcelain lamp holder suitable for use with a 60 watt 230 volt lamp

TYPE M 1 Shall indicate forward throw floodlight fitting having a body moulded from glass reinforced plastic (GRP) with light control by means of dimpled anodized aluminium reflector and 4 mm toughened soda lime flat glass secured in GRP frame hinged and secured to the main body by four stainless steel bolts, complete with lamp holder for 160 watt lamp and mounting bracket stirrup type.

TYPE J 1 Shall indicate a street lighting fitting of the post top pattern comprising an opal persper bowl with special spigot cap for mounting directly to the top of the pole and having a spun aluminium canopy held on to the bowl by means of stainless steel spring clips and neoprene sealing ring. The fitting shall be finished vitreous enamel white and suitable for one 160 watt lamp with the control gear preferably mounted in the fitting.

7.7 Air Condition and Ventilation Services

7.7.1. Scope of Work

This Section of the works covers the supply, delivery, installation, commissioning and setting to work of the air conditioning and ventilating systems for the new substation building.

7.7.2. Project Requirement

Air Conditioning shall be provided in the battery room and office room of the building. The condensing units shall be remotely located outside the building. The required capacity shall be calculated based on the battery supplier's information and ambient conditions. One additional unit equal to the largest unit size of the selected air-conditioners shall be installed in the battery room as a backup unit.

7.7.3. Mechanical Ventilation

Supply and extract ventilation shall be provided to serve the inverter rooms and generator room and cable cellar. 300 mm, 02 Nos exhaust fans shall be provided for the generator room and the inverter room and 300 mm, 01 No exhaust fan shall be provided for the cable cellar. Exhaust fans shall have automatic shutters which will shut down when the fan is not functioning. Ceiling fans shall be provided for the mess room.

7.7.4. Manufactures

Wherever possible all air conditioning and ventilating plants shall be selected from a single manufacture's product range and origin. Where this is not possible, because of practical or technical constraints, then the number of different sources of origin shall be kept to minimum.

The contractor shall provide, with his submission, comprehensive illustrated technical literature covering all plant and equipment offered. The air-conditioning sub-contractor shall have a minimum of 5 year experience. Manufacture shall have quality assurance certificate conforming to ISO 9001.

7.7.5 Standards

All air conditioning and ventilating equipment shall conform to relevant British standards and certificate to prove such conformity shall be submitted

7.7.6 Schedule of Tender Drawings

Drawing showing the proposals for all air conditioning and installations shall be submitted with Tenders. These drawings shall be listed in the appropriate schedule.

Schedules giving technical details and particulars of all air conditioning and ventilating plant must be completed and submitted with Tender.

7.7.7 Maintenance

The contractor shall be responsible for maintenance of all installation covered by this section of this specification for the period stated elsewhere in this specification.

7.7.8 Associated Civil Works

All civil and building works and attendance required associated with the air conditioning and ventilating installations shall be included within the appropriate building cost.

7.7.9 Split System Air Conditioning Units

Air cooled condensing units shall have isolated electrical supply be of the fully packaged type requiring only site connection of refrigerant pipe work, isolated electrical supply and input from the control system. Casings shall be of heavy gauge galvanized steel, weatherproofed with special corrosion resistant primer and finished in durable baked on enamel paint of a light reflective colour. Compressor used in the air-cooled condensing units shall be fully hermetically sealed complete with suitable control and protective devices. Coils shall be suitable for direct expansion refrigerant, manufactured from seamless copper tube mechanically expanded onto copper or aluminum plate fins. Condenser fans be of the axial flow type with weatherproof permanently lubricated bearings.

Internal fan coil units shall consist of centrifugal supply fan, motor, cooling coil, electrical heater battery, condensate drain pan assembly, filter and insulated cabinet with supply air head.

Refrigerant suction and liquid lines to be insulated in a accordance with Basic Standards condensate drain lines shall be supplied and shall be insulated where they pass through the building interior areas. They shall be arranged to discharge into land drains.

All air conditioners shall be conform to BS EN 14511 & EN 14825.

7.7.10 Ceiling Fans

Employer's approval shall be obtained for the type.

7.7.11 Electrical Control

Each item of plant shall be provided with local isolation and/or emergency stop buttons to facilitate maintenance inspection and emergency operation.

In case of supply failure air conditioning plants shall be disconnected without switching directly after resuming power and shall be able start manually.

7.7.12 Fire detection and Protection System

A fire detection and protection system shall be designed and installed with necessary fire equipment.. The system design, installation and equipment shall be conform to the BS 5839, BS 5306 and BS EN 15004

Chapter 8 – Transportation and Installation Work

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Chapter 8 – Transportation and Installation Work

8.1 General Specification

This section covers the Transportation and Installation of diesel generator, wind generators, battery bank , grid forming inverters, PV panels and inverters and Grid management system, laying out of control and power cables for interconnection of generating sources and forming a 230/400V distribution network with integrating all of them with Cluster Switch Box as shown in Annex C8. Installation of the equipment has to be carried out according to the laid down procedure recommended by manufacturers of equipment in the relevant sections of their Instruction Manuals.

The relevant instruction manuals for the installation of recommended equipment shall be provided by the Contractor.

If special mounting arrangements such as installation racks for batteries, mounting structures of PV panels etc. are necessary for installation and they have to be provided by the contractor and hence the associated cost deemed to be included in the installation cost of the relevant items in BOQ. In such instances, the bidder shall select materials that can withstand erosion and corrosion problems caused due to the proximity of sea to make those structures.

The lists of additional material required for the installation but not provided by the equipment supplier shall be provided by the contractor to fulfill the quality and standards requirements mentioned here. Additionally the contractor shall provide all power cables, control cables, panel boards, switchgears, isolators, fuses, surge protection devices, meters and indicators as required.

The bidder should forward his proposal and get the prior approval of Project Manager regarding the design of foundations as well as the design of mounting arrangements for the installation of equipment if installation/ mounting arrangements are not provided by the manufacturer.

The contractor should provide AC/DC surge protecting devices for all inverters, control panels, wind generators and communication network equipment used in Grid managemnt purposes to protect them from surges.

8.2 Material Transport to the Site

All imported equipment shall be transported to the site by the Contractor from Colombo harbor in a secure manner.

The Contractor is responsible for clearing all equipment from harbor and IA (SLSEA) will provide necessary assistance. The Contractor shall bear all expenses in connection with the clearing at the harbor, local transport to the Site of all Plant and material needed for the purpose of the Contract.

All equipment should be loaded, transported and unloaded according to the laid down procedures given by the manufacturers of equipment.

The most suitable vehicle has to be selected by considering the weight, volumetric size and height of each item to be transported. The transporting carriage should not be loaded beyond its maximum allowable loading capacity and all items should not extend beyond the length of the transporting bed of the vehicle. The loading and unloading has to be handled by correct size crane or hoister operated by the qualified experience persons. The road conditions have to be monitored and the route has to be selected depending on the road traffic, curvature of bends, maximum allowable weight over the

bridges and culverts and height of overhead barriers. The Contractor shall pay for any damage caused to telephone or power lines crossing the road, culverts, bridges etc. during the transportation.

The Contractor shall select less traffic hours for transportation and the job has to be done under the supervision of the Project Manager . At least one week before the bidder should produce his transportation program to the Project Managert which should describe vehicle details including their length and maximum transportable weight. The vehicle should fulfill all necessary conditions imposed by the law for running on public roads. IA is assisting the contractor by coordinating police and other security forces, government organizations and getting permissions required for transporting equipment up to the sites.

Transportation by sea can be carried out with pontoons or any other suitable method. The bidder shall pay special attention on the capacity of sea transporting vessels in the areas and their limitations. All goods shall be packed to match with the limitations of transporting vessels and jetties. The loading to the ferry and unloading at the jetty in the island should be carried out by the experienced staff with proper machineries. The service of cranes, trucks and fork lifts may not be available in the islands and needs to be imported from the main land. Equipment should be well protected from rain, dust, sea water, heavy sun light etc. during the transportation.

The vehicles have to be provided by the Contractor for transportation from jetty to the site. Certain sections of the existing road in the island may need widening or strengthening and it shall be done by the Contractor at his own cost when necessary.

The Contractor shall observe any regulations which limit loads on roads and bridges over which material may be transported.

The Contractor shall have insurance covers for the transportation of goods from Colombo harbor to the site at each island.

At the bidder's store in the island, all transported items are inspected and checked by the Project Manager for damages during transportation. The handling and storage of any material at the site shall be at the risk of the Contractor and not the responsibility of the Employer. The Contractor shall take sufficient insurance cover against any loss or damages to the material until formal handing over of completed Plants.

The Contractor shall arrange for the protection, to the satisfaction of the Project Manager , of all material against corrosion and mechanical damage during storage and erection at Site. Damaged or defective material shall not be used for construction purposes.

Suitable cable trenches should be made for power and control cables separately. Contractor shall provide necessary cables, fuses, breakers etc. required but not provided by the supplier.

8.3 Wiring

All wiring shall be carried out in a neat and systematic manner complying with the requirements of BS 7671.

The Wire colours should comply with latest edition of BS 7671.

All wires shall be fitted with numbered markers of approved type at each termination. No wires may be teed or jointed between terminal points. Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them. LV wiring shall be fully insulated and completely segregated from the panel wiring.

All conduits used in wiring devices kept in open environment should be UV protected.

LV surge protection devices should be incorporated at distribution feeder entrance and at each of the equipment to protect them from overvoltage caused by lightning and switching.

The power cable shall be 1.0kV grade, heavy duty, stranded copper conductor, UV resistant (for outdoors) PVC type. An insulated, galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general conform to BS 6346 or other relevant standards.

Instrumentation cables shall be 1.0kV grades, heavy duty, stranded copper conductor, PVC type an insulated, galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general conform to BC 6800 or other relevant standards.
The cross-sectional area of the cable chosen is such that the voltage drop introduced by it shall be within 2% of the rated system voltage.

All connections should be properly terminated from outdoor and indoor elements. Relevant codes and operating manuals must be followed. Extensive wiring and terminations (connection points) for all Plant components is needed along with electrical connection to lighting loads.
Suitable isolation devices shall be incorporated for each equipment to safely isolate them for maintenance or inspection.

Short circuit protection shall be provided by adequately rated MCB/MCCB at each circuit. Fuses may be used as recommended by the equipment manufacturer.

8.4 Equipment Earthing/Grounding

The earthing system shall be designed according to the following standards (but not limited to):

- IEC 60364 (4-41) Low-voltage electrical installations: Protection for safety - Protection against electric shock
- IEC 60364(5-54) Low-voltage electrical installations: Selection and erection of electrical equipment – Earthing arrangements and protective conductors
- IEC 61936-1 Power installations exceeding 1 kV A.C. - Common rules

The Plant should be provided with adequate earthing points. This includes earthing for lightning, system grounding separately for DC and AC active points.

Prior to drawing up the design the Contractor shall carry out a series of soil resistivity measurements at each site. The Contractor must choose the size of the stranded copper conductor and the size of mesh according to the maximum occurring ground fault currents.

The PV field shall be installed as an equipotential surface, all metallic equipment and structure shall be grounded, all PV modules shall be grounded according to standards and regulations.

System earth shall be setup in such a way that only one earth point is available in the power plant premises at any operating condition and system neutral wire shall be connected to that point. Wind Generator output is connected to the grid through an inverter. At each wind generator mounting pole, the Contractor shall install an earthing mesh of earth electrode resistance less than 1Ω with galvanized steel tapes buried at a depth of 0.5m below the ground level to facilitate earthing of wind generator mounting pole. All mechanical parts and wind turbine posts made of metal shall be bonded and connected to earth. The earthing system design must follow IEEE-80.

Earth electrode resistance shall not be more than 1 ohm. It shall be ensured that all the earthing are bonded together to make them at the same potential.

The earthing conductor and earth electrode shall be rated for two times the maximum short circuit current. The area of cross-section shall not be less than 1.6 sqmm in any case.

All metal casing/ shielding of the plant shall be thoroughly grounded to ensure safety of the personal and power plant.

RCCBs of adequate capacity shall be incorporated at appropriate places to protect lives and equipment as recommended in BS 7671.

The connection of earth electrode shall be clearly and permanently labeled "SAFETY ELECTRICAL CONNECTIONS NOT TO BE REMOVED ".

8.5 Labeling

Contractor should prepare and fix labels for all electrical items including inverter connections, PV arrays, wind generators, battery bank connections, power and control cables, devices in panels, connections of central switch box and operating mechanisms. The labeling shall indicate equipment identification number as given in the schematic diagram, any warning messages for thermal /electrical hazards and special operating precautions in brief.

Labels shall be made of corrosion resistant material with permanent lettering of a contrasting colour or, alternatively, in the case of indoor equipment, of transparent plastic materials with suitable lettering engraved on the back.

The cost for labels shall be deemed to be included in the cost for installation of equipment in price schedule.

8.6 Metering

There shall be a separate energy meters of accuracy class I at each outgoing feeders to record bi- directional energy flow. The energy meter shall record active and reactive power, power factor, current and voltages of each phase etc. It shall record system disturbances and shall be able to download on to the laptop connected to the meter.

Additionally in each circuit there shall be meters to indicate current and voltage passing through important equipment such as inverter, diesel and wind generator and batteries.

The cost for metering shall be deemed to be included in the cost for installation of grid interconnection points in price schedule.

8.7 Danger, Phase plates and Colour codes

Danger plates at doors of the cubicles placed in open space and places where opened for public and possible to have an electric shock should be made and fixed by the Contractor.

Phase identification shall be of approved types colored Brown, Black and Grey to indicate the line phases. All plates shall be able to be detached from one another. Lettering and size of plates shall be to the Employer's requirements, and generally as indicated on Drawings. All plates shall be of anti- corrosive material. If enameled iron plates are used, the whole surface of each plate including the back and edges shall be properly covered to make it resistant to corrosion. On all plates the colors shall be permanent and free from fading. With enameled plates, washers of approved material shall be provided at the back and front of the securing bolts.

The cost for danger, number and phase plates shall be deemed to be included in the cost for installation of equipment in price schedule.

In each panel boards and outgoing feeders there shall be a set of indicating bulbs to match with the color code of wires and one for each phase provided at the entrance, outgoing conductors in order to indicate the energized condition of each phase.

8.8 Locking Facilities

Locks and locking Facilities shall be provided by the Contractor on equipment installed as detailed below.

All padlocks will be provided by the contractor. Locks provided under this Contract shall be of an approved dead latch type, or padlocks as appropriate. Three (3) keys three tags (3) shall be supplied for each lock and all locks and keys shall be non – interchangeable. Where a set of locks is provided under any particular Gantry, they shall be suitable for operation with a group master key. Three (3) group master keys shall be provided for each group of locks. All locks and padlocks shall be of brass or similar non – corrodible material.

The padlocks and keys shall be engraved with an agreed identifying label of each equipment.
The following locking Facilities shall be provided:

a) Inverter cubicles.
b) Operating mechanism of Isolating switches
c) Entrance gate

Marshalling, operating and terminal kiosks or cubicle access doors and panels.

The cost for locking facilities shall be deemed to be included in the cost for installation of equipment in price schedule.

8.9 Lightning/surge protection

In order to protect the combiner boxes and the inverters of possible damages due to surge voltage in case of lightning stroke directly in or near the PV field, surge protective devices (SPD type I and SPD type II) shall be included. In addition, for communication and data lines, SPD type III devices shall be installed. Due to the expected distance between the combiner boxes and the inverters, both equipment shall be protected. SPDs type I and SPDs type II according to EN 61643-11 shall be installed in the DC PV module circuit. On the inverter side the SPDs are to be installed on the DC,
AC and control sides.

All windings of the step up transformers shall be protected from lightning induced surges by mounting distribution class surge arrestors near the transformer bushings.

The cost for SPDs shall be deemed to be included in the cost for installation of equipment in price schedule.

Chapter 9 – Testing Commissioning and Handing over

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Chapter 9 – Testing Commissioning and Handing over

9.1 General

Tests before commencing the erection, during the erection and after completion of the erection shall be carried out by the Contractor under the supervision of the Project Manager.

The Contractor shall submit the testing and commissioning plan at least one month earlier for the approval of the Project Manager. The commissioning plan shall clearly indicate power outage requirements in connected distribution network.

The Contractor shall provide experienced test personnel and equipment, tools, power supply necessary for testing and commissioning. Testing shall be carried out during normal working hours as far as is practicable. Tests which involve existing apparatus and power outages may be carried out outside the normal working hours with the consent of the Project Manager. 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 advise the Project Manager in writing at the time of commencement of site erection regarding the site power supply, which will be required for the operation of the test equipment, to enable the Project Manager to arrange accordingly or to agree alternative arrangements.

The testing and commissioning report format shall be forwarded by the contractor to the Project Manager for approval. The report shall indicate date and time, methodology, standard, instrument and their capacities, their calibration reports, test results, photos and pictures, conclusion and signatures of the persons who do the testing and witnessing.

The Contractor shall record the results of the tests clearly, on an approved form and with clear reference to the equipment identification number and items to which they refer, so that the record can be used as the basis for maintenance during the working life of the equipment. The 04 numbers of site test 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 or standard at Contractor's expense. For all equipment the contractor shall provide a valid calibration reports. 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 changed conditions at Site or by differing design, manufacture, or construction techniques.

Some tests may be needed maintaining Standard Test Conditions (STC). In several tests this can be illuminated by converting site conditions to STC by standard factors. In case of conversion of site conditions to STC is not possible, the test may be waived off with the consent of the Project Manager.

9.2 Test at Site

Tests to be conducted at site before start construction are given below.

9.2.1 Soil Investigations and Laboratory Soil Tests

The Contractor shall obtain soil samples and submit these for tests to an approved laboratory to determine the necessary properties of the soils for purpose of foundation designs. Such information is

to be detailed in an approved manner and conclusions given as to the recommended bearing pressures to be adopted. The foundation rates should include and allowance to cover all costs for this operation.
The Contractor shall include in the foundation rates the cost for testing 50 mm undisturbed core samples, which shall cover all costs including taking of samples, standard penetration tests shear vane tests transport to laboratory, etc.

The Contractor may provide his own field Soil laboratory, in which case full details of the type of testing equipment must be submitted with the Bid.

9.2.2 Ground Bearing Tests

Where ordered by the Project Manager the Contractor shall carry out ground bearing tests to determine the ground bearing capacity, by means of loading a 300 mm square plate in an approved manner. Tests shall be carried out generally in the manner described in BS 5930 or such other standard as may be approved. The overall project price shall be deemed to include for these tests.

9.2.3 Soil Resistivity Tests

Where ordered by the Project Manager, soil resistivity tests shall be carried out and recorded in an approved manner. The cost of this test is deemed to be included in each electrical installation activity mentioned in Price Schedule.

9.2.4 Records of Site Investigation Tests

All records of site investigation tests shall be detailed in an approved manner. Sample log sheets, charts, etc., shall be submitted to the Project Manager for approval before any investigation work commences. All site investigation data, charts, etc., shall be handed to the Project Manager in duplicate (copy to the Project Manager), upon satisfactory conclusion of the tests and before issue of the Taking-over Certificate. Where the Contractor carried out other tests at this own expense, not ordered by the Project Manager, the results shall be made known to the Project Manager and, conversely, where the Project Manager has had independent tests made, such information will be made available to the Contractor.

9.3 Tests During Erection

Tests to be carried out during erection are described below.

9.3.1 Testing Material to be used in Construction

The Contractor is fully responsible for carrying out all necessary material tests as required by the relevant applicable standards or as directed by the Project Manager, in order to ensure quality of raw material used for construction.

The costs of these tests are deemed to be included in the Items related with civil construction in price schedule.

9.3.2 Concrete Tests

The Contractor shall carry out tests on samples of concrete from the foundation works, as required by the Project Manager.

The test specimens shall be 150 mm cube and the mould shall be of metal with inner faces accurately machined in order that opposite sides of the specimen are plane and parallel. Each mould shall be

provided with a metal base having a smooth machined surface. The interior surfaces of the mould and base shall be lightly oiled before concrete is placed in the mould.

Tests specimens shall be molded by placing the fresh concrete in the mould in 50 mm layers, each layer being thoroughly compacted with a steel bar 380 mm long and having a ramming face 25 mm square and weighing 2.8 kg. The concrete shall be subjected to at least 35 strokes per layer. Alternatively, the concrete may be compacted by vibration, each layer being vibrated by means of an electric or pneumatic hammer or by means of a suitable vibrating table.
The test shall be made at the age of the concrete corresponding to that for which the strengths are specified. Compression tests shall be made between smooth plane steel plates without end packing and a load shall be applied axially at the rate of approximately 13.8 N/mm2 per minute. One compression plate of the testing machine shall be provided with a ball seating in the form of a portion of a sphere, the center of which coincides with the central point of the face of the place. Test specimens shall be placed in the machine in such a manner that the load is applied to the sides of the specimens as cast.

The cost of cube testing is deemed to be included in the referent tasks mentioned in price Schedule in the bid document

One cube shall be tested at 7 days to obtain an indication of the concrete strength. The remaining cubes shall be tested at 28 days and the average of their strengths shall be calculated. Should the average of the cube strengths fall below the specified 28 days cube strength, the Project Manager may order such concrete to be removed and replaced at the Contractor's expense, or the Project Manager may allow the Contractor to remove from the foundation in question a cylinder for further testing in accordance with BS1881.

The diameter of the cylinder will be not less than three times the size of the maximum aggregate and its length will be at least equal to the diameter – after allowing for preparation and facing prior to the test. Both a report and compression test will be completed for the sample in accordance with BS1881. Only one such test will be permitted from any one leg and if the crushing strength of sample is in excess of that specified, the Project Manager may, after the Contractor has made suitable repairs to the part disturbed by taking the sample, accept the work.

The Contractor is to pay for all remedial work and testing.

The results shall be handed in triplicate to the Project Manager, as soon as possible after testing.

If the results of the tests show the quality of concrete is inadequate, if other defects are revealed, the following tests shall be carried out by the Contractor at free of charge as directed by the Project Manager.

i. Rebound hammer Test to obtain approximate indication of the strength of concrete

ii. Cutting cores in accordance with requirements of BS 1881- Part 4 and checking the strength of concrete

iii. The Electromagnetic Cover Measuring test in accordance with BS 4409- Part 4 to confirm the setting out and position of reinforcements

Compactness Tests – If required by the Project Manager, the Contractor shall perform compactness test of backfilling to prove that the works to confirm to the specification.

Slump cone Test – If required by the Project Manager, the contractor shall perform slump cone test on a specified batch according to the BS 1881-102:1983.

Rejection - If any materials or workmanship are rejected by the Project Manager, the objected part or material must immediately be demolished/ removed from the site by the Contractor. Cost of such demolishing, removing from site, repair works or any other remedial measure to comply with the specification shall be to the Contractor's expense.

9.3.3 Earth Electrode Resistance

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 approximately 300m and 600 m separation will normally be required to effectively test the earthing system.

The earth resistance shall be measured during the installation and on completion as follows;

a) for each group of earth rods or earth points after completion of the connection from the test link terminal
b) each of the completed installation without any connections to outside.

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 shall be recorded with the test results.

The cost of this test is deemed to be included in each electrical installation activity mentioned in Price Schedule.

9.3.4 Additional Earth Resistance Tests

If in the opinion of the Project Manager, it may be necessary to reduce the earth resistance by approved means such as the installation of counterpoise, adding chemicals etc. the Contractor shall make further tests after the additional measures have been carried out at no extra charge.

9.3.5 Conductor and Earthwire Joint Tests

The resistances of all completed clamps, joints and terminal fittings shall be accurately measured by the contractor in the presence of the Project Manager. Where the joint consists of several parts bolted together the resistance to be measured is that of the complete assembly. The resistance of any such fittings shall not exceed 75% of the resistance of an equivalent length of conductor, measured adjacent to the fittings, and the current carrying capacity shall be at least 100% of that of the conductor. In addition, the centralization of the steel inner sleeves of joints shall be checked by the Project Manager before erection. Details of the method shall be submitted to the Project Manager. The Contractor shall provide suitable equipment (such as the Chance Digital Micro Ohmmeter or an equivalent) for making the above tests, and shall submit details of the proposed instruments to the Project Manager for approval. Suitable clamps shall also be supplied for connecting the current leads of the measuring instruments to the test sample to provide adequate surface contact at the interfaces. Test probes as used for potential contacts are unsuitable for current connections.

The cost of this test is deemed to be included in each electrical installation activity mentioned in Price Schedule.

9.4 Test on Completion

To accept the Completion, Pre-commissioning, Commissioning and Operational Acceptance tests to be conducted. Two(2) type of tests shall be carried out at various stages; (1) Contractor's Self-test; and (2) Guarantee Tests. They are defined as following with details given in succeeding clauses:

i. Contractor's Self-test (at Pre-Commissioning Stage): When the Facilities have been completed and put in a tight and clean condition, the Contractor carries out self-test and checking in preparation for Commissioning;

ii. Functional Guarantee Tests: This test shall be carried out by Contractor to ascertain whether the Facilities are able to attain the Functional Guarantees as specified in Section 3- Functional Guarantees and clause 9.4.2 in this chapter, required by the Project Manager for Operational Acceptance;

Two (2) months before the commissioning date, the Contractor shall submit to the Project Manager all relevant test documents, which shall include:

- Test program
- Test standards
- Type of inspection and tests
- Tests which are to be witnessed by third parties
- Quality control procedure.
- Description of instrumentation to be used, including accuracy, and calibration test results
- Method of data recording
- Method and equations/correction curves used for adjustment of recorded data to the design conditions.

Supplying fuel, lubrication oil and other resources required for testing and commissioning of any part or the entire Plant is the responsibility of the contractor.

Batteries should be charged if they are discharged.

Conductivity tests shall be carried out on all connections and joints, which are made on site without exception.
Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.
All test reports must be made available to the Project Manager within 2 weeks after the test.

9.4.1 Contractors Self Tests

Visual inspection: A visual inspection of all the main equipment (listed in Annex-C9) individually and the complete Plant shall be made. This shall include a check of the completeness, correctness and condition of connections, labeling, clearances, painted surfaces, wiring, pipe work, valves, blanking plates and all other auxiliary and ancillary items. Checks shall be made for oil leaks and gas leaks. Insulators shall be checked whether they are clean and free from external damage.

Wind Turbine pre-Test: This test required that each WT should be in operation continuously for 48 hours, of which at least 20 hours should be generator time (generator producing power to the dump load). Conditions for approving the test-runs were that no more 3 faults caused by the WT are allowed during the test period and that no faults are allowed within the last 10 operation hours. Each fault could not exceed being repeated twice.

Individual WT pre-test:

I. Turbine output on/off shall be tested followed by the procedure provided by the manufacturer so as to determine the wind turbine can be engaged in or disengaged properly. If the wind system consists of a dump load, the dumping feature shall be tested followed by the

procedure provided by the manufacturer so as to determine the over power protection of the wind turbine. Over speed protection mechanism shall be tested to follow the procedures from the manufacturer, so as to determine whether the over speed protection and any other protection mechanism, furling is operating properly.

II. Generator shall be checked, such as output voltage, followed by the procedure provided by the manufacturer so as to determine whether the output of the turbine is performed correctly;

III. Power wiring shall be checked followed the procedure provided by the manufacturer to determine whether the wiring from the turbine to the controller has continuity and is adequately insulated;

IV. Break system shall be checked followed by the procedure provided by the manufacturer so as to determine the brake system operating properly;

V. The input and output of the wind power inverter shall be checked to determine if the inverter is working properly;

VI. If the WT power system may consists of two or more wind turbines, each of the turbine shall be able to be checked separately;

PV pre-Test: All PV panels shall be checked to certify that all the panels are in perfect condition without any damage. All PV panels shall be tested for its performance as per manufacturer's instructions to verify its output including Voltage, current and power in watts while connected to the variable dump load. The Contractor shall be responsible to arrange all the tools and measuring instruments including the variable dump load. The test contents at least include but limited to the following:

i. Continuity and resistance testing verifies the integrity of grounding and bonding systems, conductors, connections and other terminations.

ii. Polarity testing verifies the correct polarity for PV DC circuits, and proper terminations for dc utilization equipment.

iii. Voltage and current testing verifies that PV array and system operating parameters are within specifications.

iv. Insulation resistance testing verifies the integrity of wiring and equipment, and used to detect degradation and faults to wiring insulation.

v. Performance testing verifies the Plant power and energy output are consistent with expectations. These tests also require measurements of array temperature and solar irradiance.

vi. The contractor shall perform the tests when necessary quantity of irradiation required to conduct the tests as per manufacturer's recommendations is available.

vii. The Contractor shall meet or exceed all the specifications for the PV modules as per Bidding Document.

Battery Bank pre-test: The contractor shall provide the batteries strictly in accordance with the specifications mentioned in the bidding document, particularly the connections within and between battery strings, the DC voltage, polarity protection, etc. The test includes;

i. Measurements of battery voltage, capacity.

ii. Batteries: Battery connection with in a string, the connection among strings, any shell deformation, leakage, corrosion, cracks and so on;

iii. Bracket and the ground to be placed: Corrosion, cracks, abnormal deformation, bolt preload, settlement, displacement, and so on.

iv. Battery room: Cable and cable conduit, spacing between battery racks, door(s), windows and ventilation;

v. Safety warning sign

vi. Functioning of the battery management system

vii. the battery storage shall be tested according to UN 38.3

Solar inverter pre-test: The Contractor shall be responsible to demonstrate the functioning of the Solar inverter, which should match the technical requirement of the PV array and have all the built in protections as mentioned for the solar inverter. Verification of inverter set points and temperature compensation. Verification of charging current and load control functions. All protection features, such as short-circuit protection, Polarity protection, Over charge protection, etc. Correct functioning of maximum power point tracking shall be demonstrated.

Wind inverter pre-test: The Contractor shall be responsible to demonstrate the functioning of the Wind inverter, which should be compatible with the batteries and have all the built in protections as mentioned for the solar inverter. Verification of inverter set points and temperature compensation. Verification of charging current and load control functions. All protection features, such as short-circuit protection, Polarity protection, Over charge and overdraw protection, etc. Correct functioning of maximum power point tracking shall be demonstrated.

Grid forming Inverter pre-test: The contractor shall furnish all the factory test reports for the invertor demonstrating its output and power rating. The inverter shall meet or exceed all the specifications mentioned in the bidding document. Verification of performance, single phase and three phase, power quality (frequency and voltage). Verify the polarity, overload protection, battery bank protection, and overdraw protection.

Distribution line and terminal pre-inspection: Power plant connection facilities with the distribution system shall match the prevailing distribution standards of Ceylon Electricity Board. The quantity and quality of appliances installed at the premises of power plant, including the internal wiring should meet the requirements of the bidding document.

Diesel plant performance pre-test:
For the diesel generator site tests the complete documentation of all preceding tests and commissioning steps must be available.

- Quality Assurance Documents of manufacturing at factories
- Documentation of all Factory Acceptance Tests (FAT)
- The generator shall meet or exceed all the specifications mentioned in the bidding document.

The testing program for the diesel units shall consist of the following:

- Mechanical completion,
- Start-up Tests

Performance should be verified by measuring the delivery of agreed Net power, net specific fuel consumption, net specific lube oil consumption, · Noise level, and operation under voltage greater than 20%/s.
.

The contractor shall keep a complete record of the pre-test for review in case.

9.4.2 Functional Guarantee Tests (operational tests)

Contractor shall carry out all the Functional Guarantee Tests as specified in Section-3 and the tests described below.

Functional Guarantee Tests (Operational tests) shall be carried out according to the instructions and recommendations given in the manufacturer's technical literature. The Contractor shall commission according to a documented procedure to ensure that the Plant is safe: It has been installed in accordance with the requirements of CEB standard: it has been installed following the manufacturers' instructions: It is operating correctly in accordance with the Plant design.

Manual operation of switches shall be subject to operational tests to confirm contact resistances, simultaneous operation of all phases where applicable and the ease of operation. Checks shall be made on interlocks, local indications and operation of auxiliary contacts.

The Contractor shall carryout this test while plant is connected to the distribution network.

Key steps of a Plant commissioning procedure include:

i. Completing visual inspections.

ii. Verifying compliance with Project Manager's Requirements described in Section-6.

iii. Conducting electrical verification tests as specified by the manufacturers (Voltage, current, insulation resistance, polarity test, etc.).

iv. Verifying Plant functionality including start-up, operations, shut-down and emergency procedures.

v. Verifying Plant power output and energy production meet performance expectations.

vi. Completing Plant documentation, including changes for as-built drawings.

vii. Conducting user orientation and training on Plant operations and safety.

viii. The measuring instruments including recordings from the GMS should match the output from the Plant.

This test should be consistent with the Specifications, product data sheets, recommendations of the manufacturers and the requirements of the Project Manager, who shall certify to the Contractor that the particular pieces of equipment being so tested, the number and types of tests, the manner in which such tests are carried out, and the methods of testing and the criteria for the successful completion of such tests, and the other parameters of such tests are adequate to demonstrate that the design, installation and performance (including energy production and the reliability thereof) of the Plant, and all of the components thereof, meet or exceed the specifications outlined in the Bidding Documents.

WT performance test: WT's performance will be tested. The test will be carried out under the following way: The output of PV array shall be disconnected and the loads shall be all "ON" so as to let the WT can output its maximum power based upon the available wind resource by that time. If the load is not enough so as to result in the output from the WT is reduced, some dump load shall be applied. The test will last seven (7) days. The average wind speed (m/s), current (A) from wind power charging controller or inverter and input/output voltage shall be sampled at 10 minutes interval. The data can be retrieved from the monitoring system. Based upon the above monitored data, the average wind speed WSreal, and Total Energy produced (kWh) during test period will be calculated. Also, the theoretical WT output based upon the Power Curve claimed by the Contractor (or WT manufacturer) and the average wind speed WSreal will be also calculated.

Total Power Production = can be measured or calculated based on the measurements of current and voltages at 10 minutes interval from the beginning of the test time.

Then, the Theatrical Power Production will be calculated based upon WS_{real} and Power curve provided by the Contractor (SWT manufacturer) following AWEA Standard 9.1-2009.

The Total Power Production will be compared with the Theoretical Power Production:

$$E = \frac{\text{Total Power Production}}{\text{Theoretical Power Production}}$$

If E ≥ 0.95 then the SWT energy production is satisfied, if E< 0.95,this tells the SWT' s energy output is less than its statement. This test shall be carried out under the days with better wind speed.

Solar array Test: Solar array test includes single panel efficiency test and PV array test.

i. For Solar panel efficiency test, no less than 10% of PV panels, will be randomly selected. Selected PV panel will be disconnected with all others. A professional PV module IV tester (includes radiation sensor and temperature compensation) will be used to test the I and V. The result will be compared with the specification claimed by the panel label. If more than 5% of the selected panels are below the claimed capacity with its tolerance, more panels shall be selected for another test. If the second test is still failed, then the PV array shall be rejected.

ii. PV Array performance test: Solar array shall be tested after the system installed. A Solar Module IV tester shall be used. The test point shall be the place between solar charger output and DC-Bus. The battery shall be discharged so as to have big load for PV array. For sunny day, one test is enough. The solar radiation shall at least >700W/m2. Then the tested results will be calculated to STC condition so as to be compared with the Project Manager's specs and requirements. That is done by converting the site conditions to STC by standard factors.

Diesel Plant performance test

The Provisional Acceptance Test for the Diesel Plant will be performed after successful completion of the Start-up Tests of the Works. The Provisional Acceptance Test will cover the Reliability Test Run and the Performance Tests.

The Contractor shall be responsible for providing all supplies required for carrying out such tests, including the fuel used during Reliability Test Run and Performance Tests.

(i) Reliability Test Run

After successful completion of Start-up Tests and after relevant test protocols have been accepted by the Project Manager, the Contractor shall be allowed to prepare the Diesel Plant for the Reliability Test Run.

The Reliability Test Run shall be carried out for all diesel generators in operation and shall last for a continuous period of at least three (3) days.

During the specified period, each section and related equipment and systems shall be operated continuously and/or as required by the Project Manager. Taking into consideration a low load-demand of the grid the Contractor is requested to eradicate the produced power in resistors or other suitable dump load equipment, if necessary.
In the event of interruptions to the Reliability Test Run, for which the Contractor is responsible, the length of the Reliability Test Run per diesel generator can be extended by a period equal to the total duration of the interruptions.

The Reliability Test Run will be deemed successful if the following guarantee criteria are met:

- Guaranteed Power

- Fuel consumption
- Lube-oil-consumption
- Emissions

(ii) Performance Tests

During the Reliability Test Run period the Contractor shall demonstrate by means of Performance Tests that diesel units as well as related equipment and systems are ready for commercial operation.

Performance Tests together with measurements of power, of fuel- and lubrication-oil consumption and exhaust-gas and noise emissions shall be conducted in accordance with the relevant standards.

The full-load (COP) measuring period will cover 4 hours, where measurements depend on local grid stability or system demand and will be taken every hour. The part-load-measurements for 50%, 75% and 80% will cover a period of 1 hour.

Calibration certificates of the measuring equipment with a maximum validity of 1 year shall be presented by the Contractor.

The net Diesel Plant output during the Performance Tests (electrical output at the diesel generator terminals minus electrical auxiliary consumption or electrical power at the outgoing feeders) shall be measured.

The curves required for the correction of the power output and specific fuel consumption to the site specified ambient conditions shall be prepared by the Contractor before starting the Performance Tests and listed in the technical schedules of the Diesel Plant performance and diesel generator performance.

All margins required for instrument inaccuracies and for all other reasons shall be deemed to be included in the guarantee figures of:

- Guaranteed Power
- Fuel consumption
- Lube-oil-consumption
- Emissions

The time consumed in start-up and trial operation, Initial Commercial Operation (ICO), Performance and Acceptance Tests shall be considered as a part of the completion period

Total Hybrid System performance Test: The Capacity of the Plant will be determined by measuring the output in kWh at the output of the inverter recorded by the measuring instruments while the ratings of the WTs and solar panels shall be correlated with the prevailing ambient conditions and the data from the GRID MANAGEMENT system. The WTs and solar modules shall operate at their maximum continuous ratings depending on the ambient conditions to meet the connected load such that during the test period the design parameters/rating of the units, batteries, and the inverter will not exceed and all protections shall be intact. Two indexes will be used for system performance tests: Load coverage (%) and System Availability (%)

i. Load coverage (%) = $\frac{\text{Power available time (hrs)}}{\text{Total time of the test period (hrs)}}$' where, Power available time is the hours that the power system output matches the load demand during a certain testing period, such as seven days or one complete year. Power system is operating under normal condition, but its output does not matches the load, which includes two situations: The first, is that some load must be shut down because less power output from the power system is available, Second, the power system is not available due to any failure; Total time of the test period is the total hours during a certain testing period, such as 168 hours for seven (7) days. If the Power output matches the load demand all time during the test period, the Load coverage will be 100%.

ii. System availability:

Equipment availability (%) = $\frac{\text{Total time of the test period (hrs)} - \text{Equipment failure time (hrs)}}{\text{Total time of the test period (hrs)}}$, where: major equipment includes WT(s), PV array, inverter, battery bank, and distribution system. Total time of the test time is the hours during the whole test period, such as 168 hours for seven (7) days. Equipment failure time is the hours that the resource is available, but the equipment does not working due to equipment failure.

System availability (%) = $\frac{\text{Total time of the test period (hrs)} - \text{System failure time (hrs)}}{\text{Total time of the test period (hrs)}}$, where the system stands for whole power generation and distribution system. Total time of the test time is the hours during the whole test period, such as 168 hours for seven (7) days. System failure time is the hours that the resource is available, but the power system does not working due to any kind of failure.

System Load Change Responding Test: This test will include follows:

i. Plant shall be demonstrated to be capable of a step increase in load of five (5) percent of the connected load provided the Plant load is greater than twenty five (25) percent of the connected load. It shall also be demonstrated to be capable of withstanding a sudden loss of demand of ten (10) percent of rated output from any load in the range thirty-five (35) percent to hundred (100) percent. The Plant must not trip and must otherwise remain in a safe condition. If the Plant Load coverage, equipment and Plant availability is not match the minimum requirement by the Project Manager, the Contractor is responsible to fix the problem or replace the failed parts, and test again by himself, and apply for acceptance and commissioning once again.

ii. The Contractor shall not be entitled to carry out more than three (3) system performance tests; provided, that no Test undertaken by the Contractor shall be counted against such three (3) Tests if the Contractor is prevented from completing the test due to Climatic Conditions as recorded through the Grid Management system

iii. In the event of a shortfall persisting in the tested Capacity exceeding fifteen (15) percent of the Contract Capacity after all the tests have been satisfactorily completed, the Owner shall have the right to reject the Plant.

iv. In case of shortfall in the tested capacity is less than 15% of the contracted capacity, the Contractor shall pay liquidated damages at the rate of $ 8/Watt shortfall in the tested capacity with a ceiling of 10 % of the Contract price which shall be deducted from the final payment due to the Contractor.

v. A reliability run test will be carried out as the Commissioning tests and must be satisfied prior to the Plants being certified as "Commissioned" by the Project Manager. The run will be for a period of seven (7) days (one hundred and sixty eight (168) continuous hours without overloading the individual equipment beyond its safe operating limits and all the protections intact. The test shall have been satisfactorily completed only if it continues without any interruption provided however, that the ambient conditions are conducive, In case of no wind and solar days, the Plant should continue to meet the load demand for a minimum period of 36 hours.

The standard test report complying with the latest edition of BS 7671 should be provided for the wiring of power plant building.

Insulation Resistance Tests at 1,000 V AC for one minute are if possible to be carried out on all protection, control, alarm and indication circuits to ensure that wiring is in satisfactory condition.

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.

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.

9.5 Handing Over

Upon completion of the works, the contractor shall carry out Insulation Resistance test between each phase and Earth and between phases by means of an approved insulation tester, check Phase Sequence and Line Continuity to prove that the installed Plant is ready to energize.

The completed Plant shall be energized at full working voltage before handing over. If the Project Manager or the Project Manager shall desire to make any other special tests on the completed Plant, the Project Manager shall provide apparatus for such special tests. The Contractor shall provide such labour, transport and other assistance as required without extra charge, for energizing line and any special tests.

The Contractor shall prepare all documents such as Built Drawings, Test Reports, list of settings, cabling routes, operational and maintenance manuals and any other documents required for handing over of completed Plant and hand over the completed Plant to the Operation and Maintenance Divisions of the Project Manager, as directed by the Project Manager. The Contractor shall remedy any defects found at the time of joint inspection with the representatives of Operation and Maintenance Divisions of the Project Manager and carry out any necessary improvements as directed by the Project Manager to comply with the specification.

9.6 Training operation and Maintenance staff

The contractor shall operate the Plant about 400 hours continuously without any failure before handing over to CEB. CEB operational staff is witnessing the operation during this period while getting on hands on training on operational and maintenance activities.

The contractor shall provide CEB operational and maintenance manual prepared by him regarding operation, isolation, maintenance, testing procedures for each the Plant as recommended by the equipment suppliers.

Chapter 10 – Transformer

Content

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Chapter 10 – Transformer

10.1 General

Hybrid system output generated at 400V shall be steeped up to 11kV and distributed through 11kV network in all three islands. Always two nos of step up 0.4/11kV transformers shall be supplied and installed by the contractor at the grid interconnection point. Transformers provided shall operate in parallel with each other and one transformer capacity shall be enough to provide the entire generatio of the hybrid system output if necessary.

Transformer capacity shall be decided by the bidder considering the possible loading effect caused by harmonics generating from the hybrid system.

This Specification covers the general requirements of the design, manufacture, testing, supply and delivery of 0.4/11kV distribution transformer.

System Parameters

a)	Nominal Voltage	400/230 V	11 kV
b)	System highest voltage	440/254 V	12 kV
c)	System frequency	50 Hz	50 Hz
d)	Method of earthing	Non effectively earthed	Effectively Earthed
e)	System fault level	25 kA	12.5 kA

Service Conditions

a)	Annual average ambient temperature	35°C
b)	Maximum ambient temperature	40°C
c)	Maximum relative humidity	90%
d)	Environmental conditions	Humid tropical climate with heavily polluted atmosphere
e)	Operational altitude	From MSL to 30m above MSL
f)	Isokeraunic (Thunder Day) level	100 days/year

Applicable Standards

The equipment and the components supplied shall be in accordance with the latest edition of the standards specified below and amendments thereof.

a)	IEC 60137 (2008)	Insulated bushings for alternating voltages above 1 000 V
b)	IEC 60156 (1995)	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method
c)	IEC 60296 (2012)	Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear
d)	IEC 60076-7:2005	Loading guide for oil-immersed power transformers
e)	IEC 60076-10:2016	Determination of sound levels
f)	IEC TR 60616:1978	Terminal and tapping markings for power transformers
g)	IEC 60076-4:2002	Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
h)	IEC 60815: 2008	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions
i)	IEC 62217: 2012	Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria
j)	IEC 60076: 2015	Power transformers
k)	BS 2562 :1997	Specification for cable boxes for transformers and reactors
l)	BS EN 10025 :2008	Hot rolled products of structural steels
m)	BS 5493: 1997	Code of practice for protective coating of iron and steel structures against corrosion

10.2 Technical Requirements

Medium Voltage Characteristics

(a)	Lightning impulse withstand voltage (peak)	75kV
(b)	One min power frequency withstand voltage	28kV
(d)	Winding type	star

Low Voltage Characteristics

(a)	Nominal Voltage	230/400 V
(b)	System Highest Voltage	254/440 V

(c)	One minute test voltage	3000 V
(d)	Impulse (1.2/50µ) wave withstand voltage	6000 V
(e)	Winding type	Delta

Other Performance Characteristics

Table 1: Maximum acceptable losses

Transformer	No Load Losses (/W)	Full Load Loss (/W)
100 kVA, 11kV / 400V	270	2150
160 kVA, 11kV / 400V	360	2650
250 kVA, 11kV / 400V	550	3700
400 kVA, 11kV / 400V	770	4700

10.3 Basic Features

The transformers shall be of hermetically sealed type and suitable for outdoor application. They shall be fully rated at ambient temperature of 35° C and the typical operating characteristics specified in clause 5.0 technical requirements shall apply to all transformers.

10.3.1 Transformer Construction

The transformers shall be double-wound, oil immersed naturally cooled and hermetically sealed fully filled type.

The transformers for rating upto 250kVA shall be of pole mounted type and the 400 kVA shall be of plinth mounted type.

The core shall be of high grade cold rolled grain oriented silicon sheet steel and securely clamped. The transformer core shall be of three limbs stacked core type.

The primary and secondary windings shall be constructed from high conductivity E.C. grade copper. All turns of windings shall be adequately supported to prevent movement. The high voltage winding shall be of layered winding and the low voltage winding shall be of foil winding using Copper sheets.

The core and coil assembly shall have the core and coils rigidly connected. The core/coil assembly shall be mounted on the cover plate so that the assembly could be removed from the tank using the suitably placed lugs provided on the cover plate.

No material which can be deleteriously affected by the action of oil under the operating conditions of the transformers shall be used in the transformers or leads or bushings.

To ensure that the core and coils of transformers are seated on the floor of the tank, supporting frames shall be designed to accommodate variations in tank height. The core and coil assembly shall be rigidly connected to the tank and suitably closed lugs shall be provided for removing the core and coil assembly from the tank.

Construction features shall permit local repairs to be easily carried out in the event of equipment failure.

10.3.2 Transformer Tank

The transformer tank shall be fabricated from steel and shall be of robust construction. Care should be taken at the manufacturing stage so as not to have leaks during transportation or when the transformer is continuously operated at rated power.

With the exception of radiator elements, all external joints shall be seam welded. There shall be only one vertical seam weld for the fin radiator and the other three vertical corner edges of the transformer shall be formed by bending. Corner ribs shall be avoided for the fin radiator. The bearing surface of the tank to which bushings are clamped shall be substantially flat.

All matching faces of joints shall be made oil tight and finished with a smooth surface to ensure that the gasketing materials make a satisfactory joint.

Flanges and covers of tanks shall be of sufficient thickness to prevent any depression occurring, which would retain water around the bolts. The horizontal edges of the cover plate shall be bent over the tank flange to facilitate water dripping out of the tank. The bent collar width shall be about 10mm to 15mm.

All the nut and bolts used shall be hot dip galvanised and spaced at sufficiently close intervals to avoid buckling of either flange or covers and shall provide reasonably uniform compression of the gasket.

Each transformer shall be provided with a minimum of two closed lifting lugs. The minimum diameter of the hole or width of the slot shall be 25 mm. The two lifting lugs shall be located such that there would be a minimum of 50 mm between the lifting chain and the nearest part of the bushings.

All transformers shall be suitable for outdoor mounting on pole or plinth platforms and shall have four mounting lugs with 12 mm diameter holes suitable for bolting the transformer to the platform. Bolt hole spacing shall be as specified by the purchaser to suit mounting requirements.

10.3.3 Transformer Sealing / Gasket

The transformers shall be of the hermetically sealed type and provided with a satisfactory lid sealing gaskets.

The gasket shall of the good quality to maintain the sealing effect through its life span and shall prevent seeping of oil due to ageing and extreme operating temperature

Gaskets provided with the transformers shall be suitable for making oil tight joints, and there would be no deleterious effects on either gaskets or oil when the gaskets are continuously in contact with hot oil. No gaskets shall be used in which the material of the gasket is mounted on a textile backing.

Exterior gaskets shall be of rubberized cork material, weatherproof and shall not be affected by strong sunlight.

10.3.4 Internal and External Finish

Both internal and external surfaces of the transformer shall be hot dip galvanized in compliance with IBS EN ISO 1461: 2009. The surfaces shall be free of any zinc burrs both inside and outside.

After galvanizing, the external surface shall be prepared for powder painting by applying a suitable etch primer. The effect of etch primer shall be to avoid powder coating being peeled off from the galvanized surface. The powder shall then be applied and the powder used shall be an epoxy polyester cured with hydroxyl alkyl. The powder coating thickness shall not be less than 50µm.

10.3.5 Rating Plate

A brass /stainless steel rating plate shall be fitted to each transformer. The information shall be deeply etched including the diagram of the connections of the windings, the vector diagram showing the general phase relations of the transformer, and a diagrammatic plan of the transformer cover showing the terminal positions and marking and other essential particulars.

The plate shall be mounted in an accessible position and following information shall be clearly and indelibly marked in English language.

a) Transformer type	b) Manufacturer's name
c) Manufacturer's serial number	d) Year of manufacture
e) Number of phases	f) Rated power at 30 ◦ C
g) Rated frequency	h) Rated voltages
i) Rated currents	j) Connection symbol
k) Mass of insulating oil	l) Insulation levels
m) Details regarding tapping	n) Gross weight
o) Impedance voltage at rated current Type of cooling total mass	

10.3.6 Bushings

All bushings shall be of porcelain clad or Polymer, of the highest quality and comply with IEC 60137 or IEC 62217 respectively. Creepage distance of the bushing insulator shall be 300mm for 12kV transformers. They shall be sealed in a manner to prevent ingress of moisture and to facilitate removal. The neutral bushings and stems shall be identical to those provided for phase terminations. Bushing palms shall be made of brass and be suitable for the bolting of conductor compression lugs.

The palms shall be suitably dimensioned, to suit the bushing rod and the holes spaced sufficiently apart to enable tightening of bolts using standard spanners and to prevent overlap of lugs. The LV bushing palms shall be as indicated in the drawing No. DS&S/2000/98A.

10.3.7 Terminal Leads

Outgoing leads shall be brought out through bushings, the leads shall be such that the core and coils could be removed with the least possible interference with these leads, and they shall be specially supported inside the transformer to withstand the effects of vibration and short circuits.

The leads shall be so fixed that they do not break at the connection and would not twist and touch each other in case the bushing is turned accidentally.

10.3.8 Earthing Connections

Earthing connections shall be provided with connection facilities for 50mm^2 copper stranded conductor.

Three bolts of M12 size shall be located on either side of the tank base (two) and on the cover plate (one).

10.3.9 Off Load Tap Changer

Transformer shall have off load tapping on 11kV winding for 11kV voltage adjustment up to ±5% at 2.5% steps..

The tappings shall be selected by an 'off load' tapping switch with an external hand wheel with provision for locking on to a selected tapping. The shaft shall be adequately sealed so that no seepage of oil occurs under all conditions of service.

The voltage operating positions, together with tap change positions shall be clearly and indelibly marked.

10.3.10 Surge Arrester Mounting Bracket

The surge arrester mounting bracket made of steel shall be provided on the transformer cover plate.

The bracket shall be hot dip galvanised and suitable to accommodate three Nos. of surge arresters as indicated in the drawing No. DS&S/2000/98B

10.3.11 Oil

All transformers shall be filled to the required level with a new, unused, PCB free, uninhibited, clean, standard mineral oil in compliance with IEC 60296. Detailed literature of the type of oil and data sheet shall be furnished with the bid. For topping up purposes, a list of oils that are compatible with the supplied oil shall also be furnished with the bid.

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10.3.12 Pressure Relief Valve

The transformer tank shall be fitted with a suitable pressure relief valve to operate when the pressure exceeds 0.3 bars to prevent explosion of the transformer due to internal fault.

10.4 Additional Requirements

10.4.1 Terminal Marking

All transformers shall have the primary and secondary terminal markings plainly and indelibly marked on the transformer adjacent to the relevant terminal. These markings shall be 25mm in height.

10.4.2 Radio Interference

When operated at voltage even up to 10% in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication.

10.4.3 Routine Tests

The following routine tests as per IEC 60076 shall be carried out on all the distribution transformers ordered and the routine test reports shall be made available for the observation of the CEB and SLSEA Inspector at the time of inspection.

a) Measurement of winding resistance
b) Measurement of voltage ratio and check of voltage vector relationship
c) Measurement of impedance voltage, short-circuit impedance and load loss
d) Measurement of no-load loss and current
e) Dielectric routine tests
f) Oil breakdown test
g) Pressure test at 0.25 bar above atmospheric

10.4.4 Spare Parts and Tools

The supplier shall specify the spare parts required for proper and continuous functioning of the transformers. The supplier shall also specify if any special tools are required for the maintenance of transformers other than those conventional for transformers. A schedule of prices and quantities of spare parts and special tools shall be given by the supplier.

10.4.5 Outline Drawings, Maintenance Manual and Packing

Outline drawings and other necessary drawings baring an effect on customers' installation shall be provided with each transformer and a comprehensive maintenance manual shall also be provided.

10.5 Quality Assurance

The manufacturer shall possess Quality Assurance Certification for the manufacture of distribution transformers for the plant where the manufacture of distribution transformers is done, in accordance with ISO 9001:2008 or latest edition. Bidders shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

10.6 Information to be furnished with the Offer

10.6.1 The following Information shall be furnished the offer

a) Particulars requested in annex - A.
b) Constructional features and materials used for components
c) Quality assurance Plan (QAP)
f) Certified copy of the quality assurance conforming to ISO 9001.

10.6.2 Type Tests Certificates

The following Certificates of Type tests as per IEC 60076 by an internationally recognised independent testing authority for voltage and capacity not less than required one shall be furnished with the offer

a) Lighting Impulse withstand voltage test
b) Short-Circuit Tests
c) One minute wet power frequency withstand voltage test
d) Temperature-rise test
e) Acoustic sound level measurements

The Type Test Certificates for short circuit tests shall be from an accredited independent testing authority acceptable to the Employer.

Proof of accreditation by a national/international authority shall also be forwarded with the offer.

Test Reports shall be complete including all the pages as issued by the Testing Authority. Parts of the Test Report shall not be acceptable.

The supplier has to provide the calculation for thermal stability and forces on windings and clamping in case of a short circuit fault.at transformer terminals.

10.7 Inspection and Testing

Inspection

The selected Bidder shall make necessary arrangements for inspection of the equipment by two (2) Engineers appointed by the Purchaser and also to carry out in his presence necessary Acceptance / sample tests of the materials and equipment, offered.

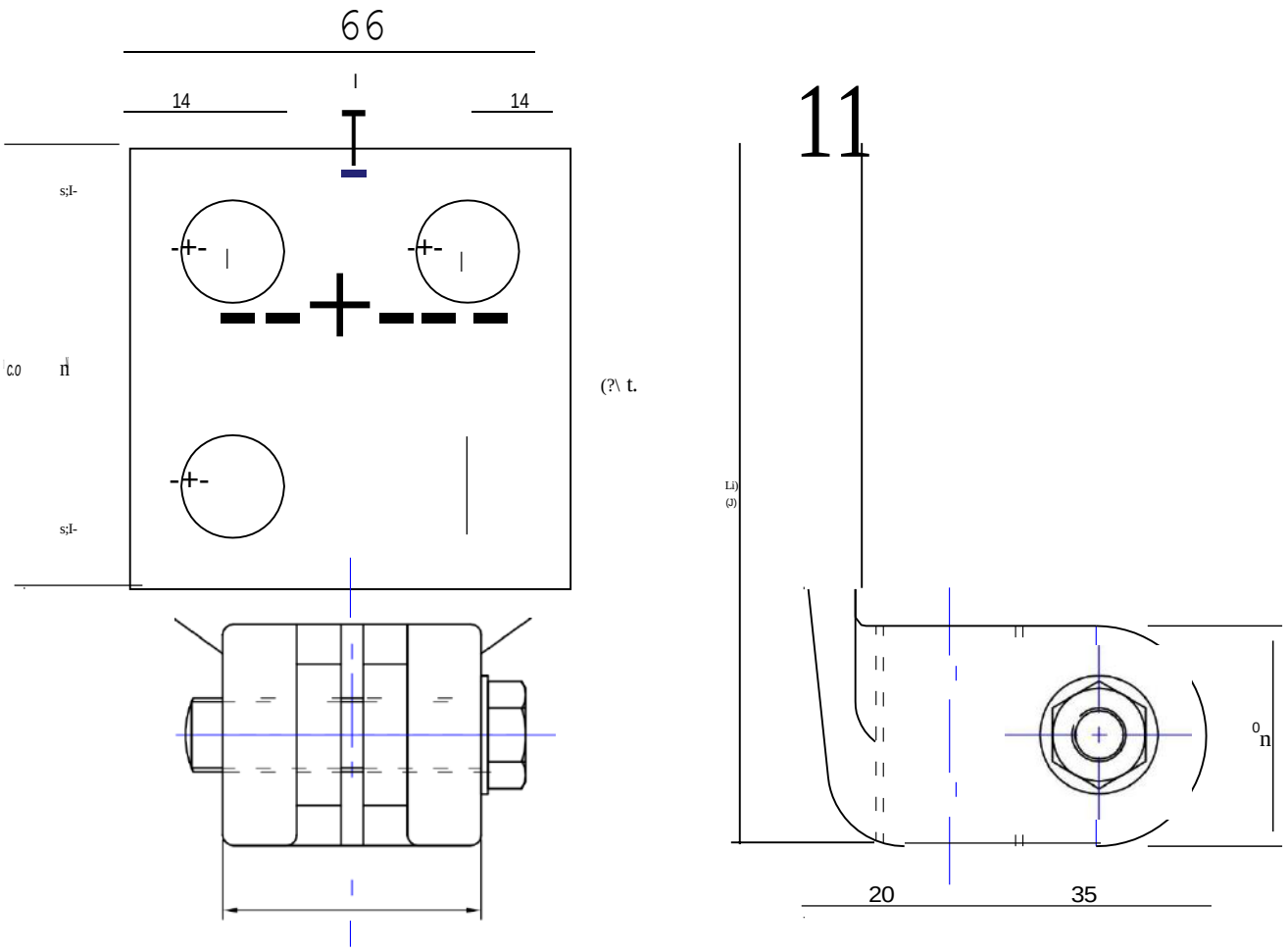
Acceptance /Sample Tests

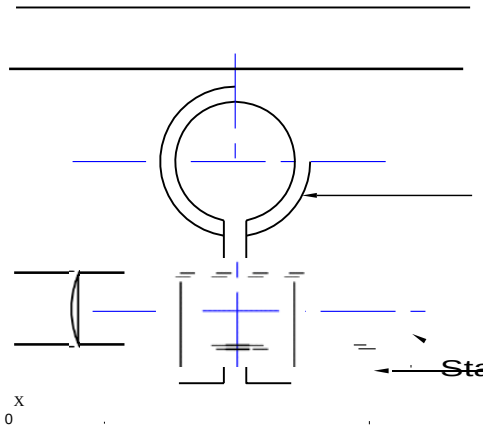
The following Acceptance/Sample tests conforming to IEC 60076 (1993) shall be witnessed by the Engineer. Extra copies of these Test Certificates shall also be supplied with the equipment.

a) Measurement of winding resistance
b) Measurement of voltage ratio and check of voltage vector relationship
c) Measurement of impedance voltage, short-circuit impedance and load loss
d) Measurement of no-load loss and current
e) Dielectric routine tests
f) Oil breakdown test
g) Pressure test at 0.25 bar above atmospheric

10.8 Annex

A - Details of Flag for 250A / 630A Bushings
B - Surge Arrester Mounting Bracket

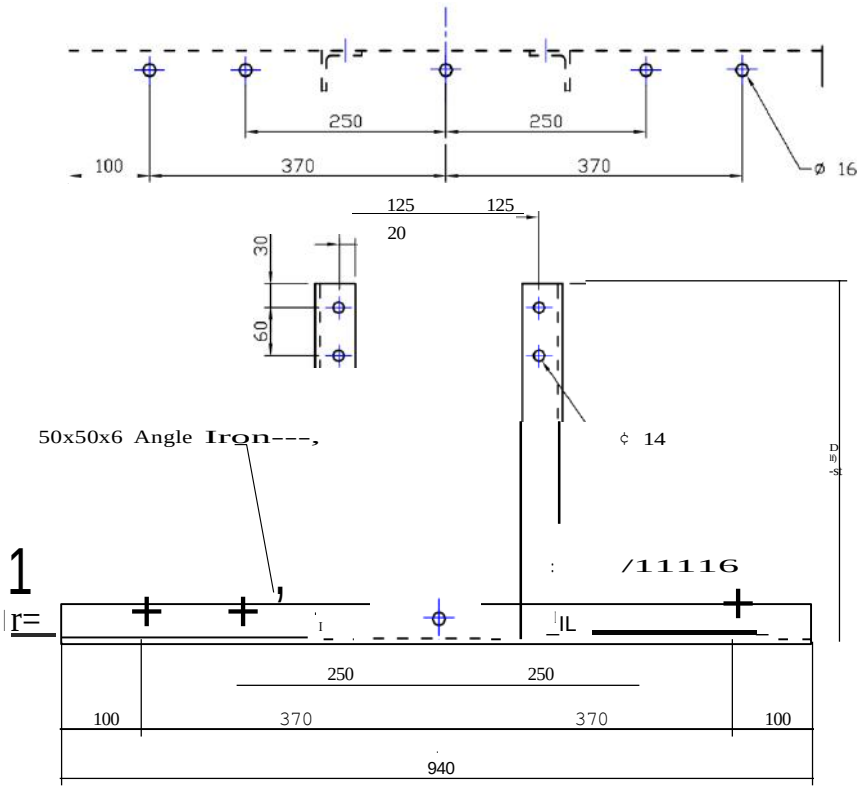




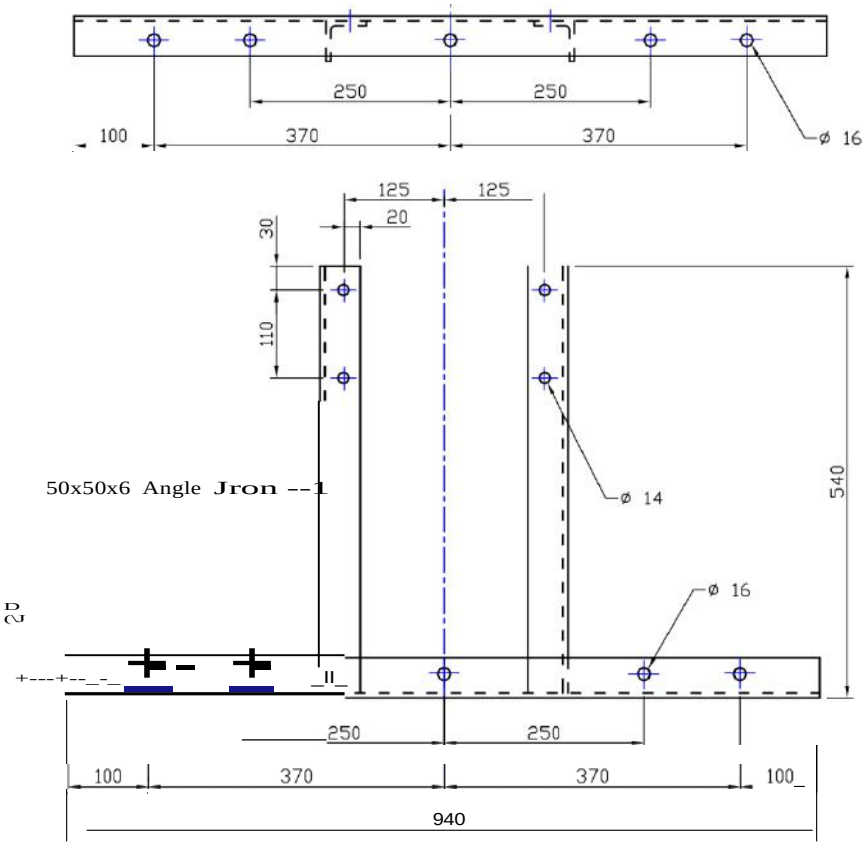
All dimensions are in mm

NOTE
Material : Tin Plated Brass

CEYLON ELECTRICITY BOARD	**DISTRIBUTION STANDARDS & SPECIFICATION**	SCALE : NOT TO SCALE
	DETAILS OF FLAG FOR DT 630A / 250A BUSHING	DRAWN : LALANI
		DATE : Aug. 2000
	DESIGNED BY / APPROVED BY	DRG. NO : DS&S/2000/98A
DIST. PLANNING BRANCH	E.E. (DS & S) / CHAIRMAN, SPECIFICATION COMMITTEE	CAD NO :



100 - 400 kVA 11,33 kV /415 V TRANSFORMERS



630 - 1000 kVA 11,33 kV /415 V TRANSFORMERS

All diemensions are in mm.

CEYLON ELECTRICITY BOARD	**DISTRIBUTION STANDARDS & SPECIFICATION**	SCALE : NOT TO SCALE
	SURGE ARRESTOR MOUNTING BRACKT	DRAWN : LALANI
	DESIGNED BY / APPROVED BY	DATE : Aug. 2000
		DRG. NO : DS&S/2000/098/B
DIST. PLANNING BRANCH	E.E. (OS & S) / CHAIRMAN, SPECIFICATION COMMITTEE	CAD NO :

Part C - Drawings

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Annex C1: Geographical Locations of Sites

Figure C1: Geographical Location of the site at Delft

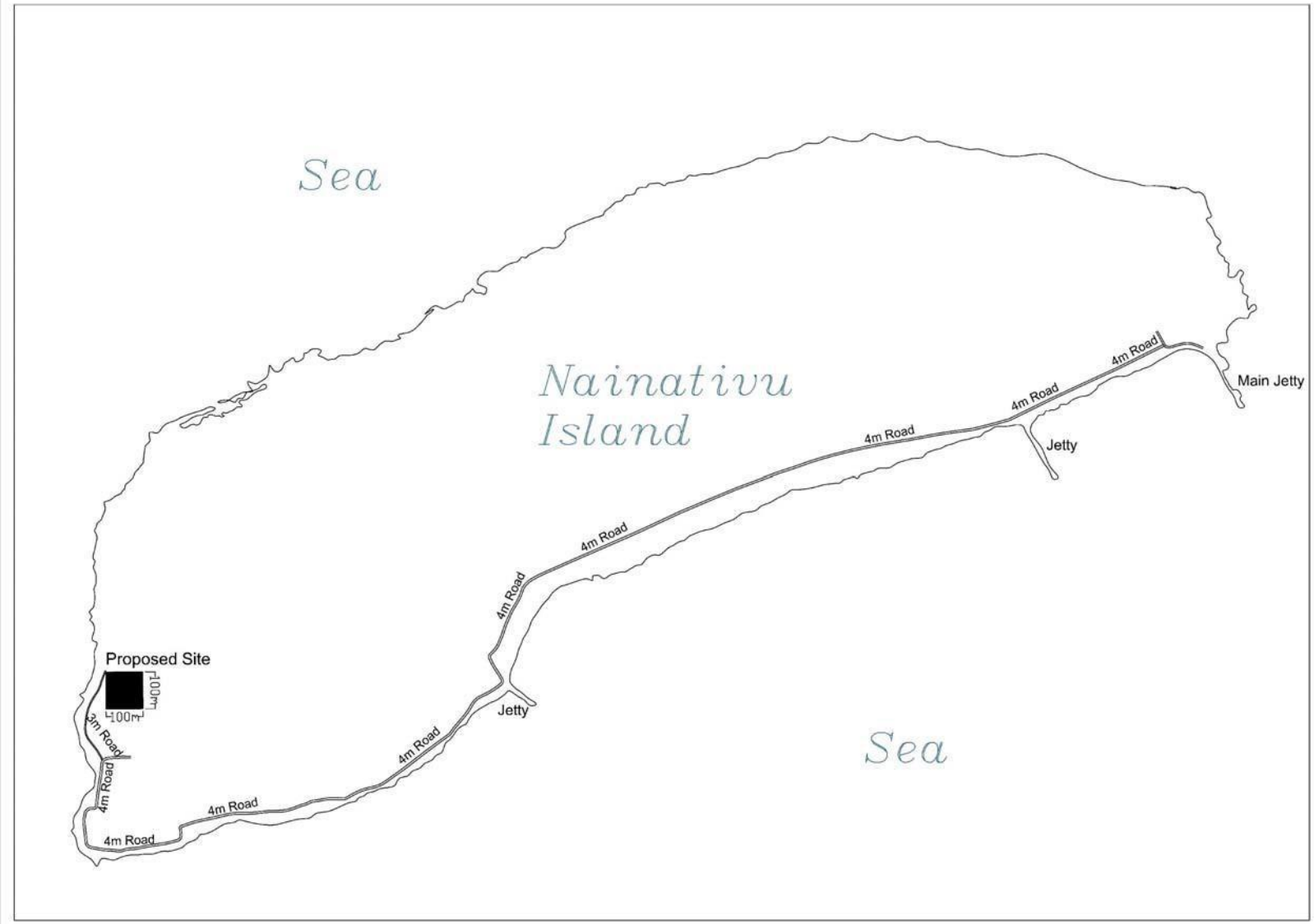


Figure C2: Geographical Location of the site at Nainativu

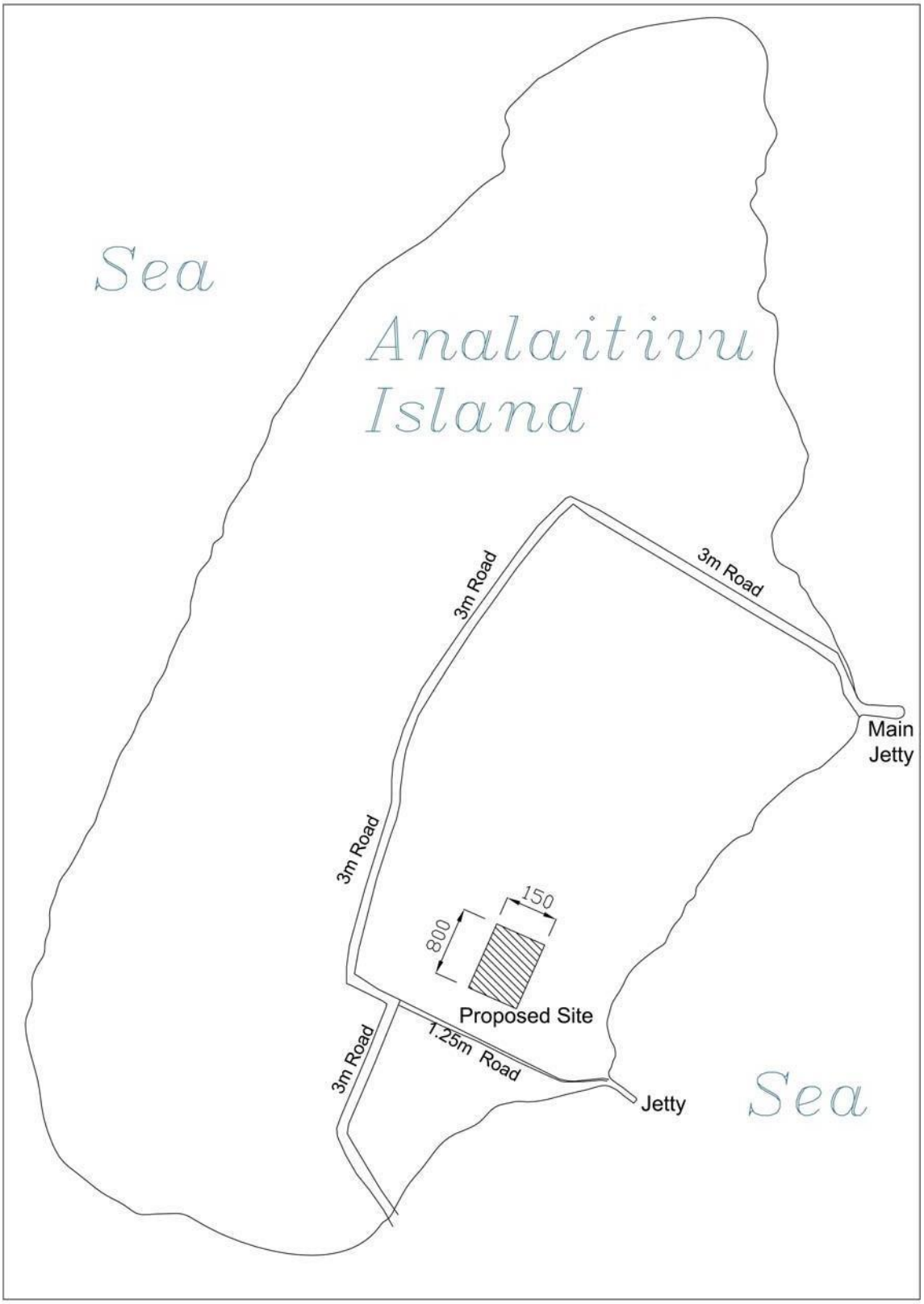
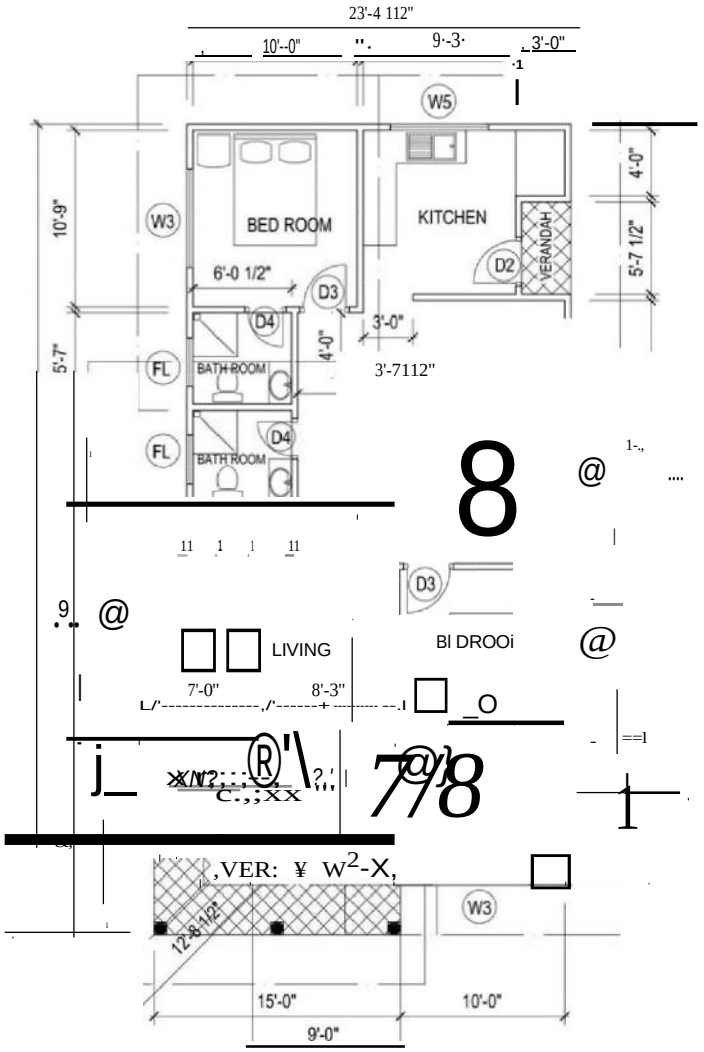


Figure C3: Geographical Location of the site at Analativu

Annex C2: Plans for Permanent Site Quarters



GROUND FLOOR PLAN

All Dimensions are in Feet & Inches

CEYLON ELECTRICITY BOARD	PROJECTS A DfIEAVYMJ\I TE ANCE-DDI		
	Supervising Staff Quaters Floor Plan For All Islands		
	1 ------- t--, ::-•-.•-.1	,ba=m, ------ 1t-C	od-ol
	C. &gjnocr(DDII	D.0 1.(P&IIM) DDI	
	Drg. No. : DD1/P&HM//DWG/Quaters/Superviser/All Island/01		Date : 2211/2016

Figure C4: Plan for permanent Site Office for Supervisory Staff

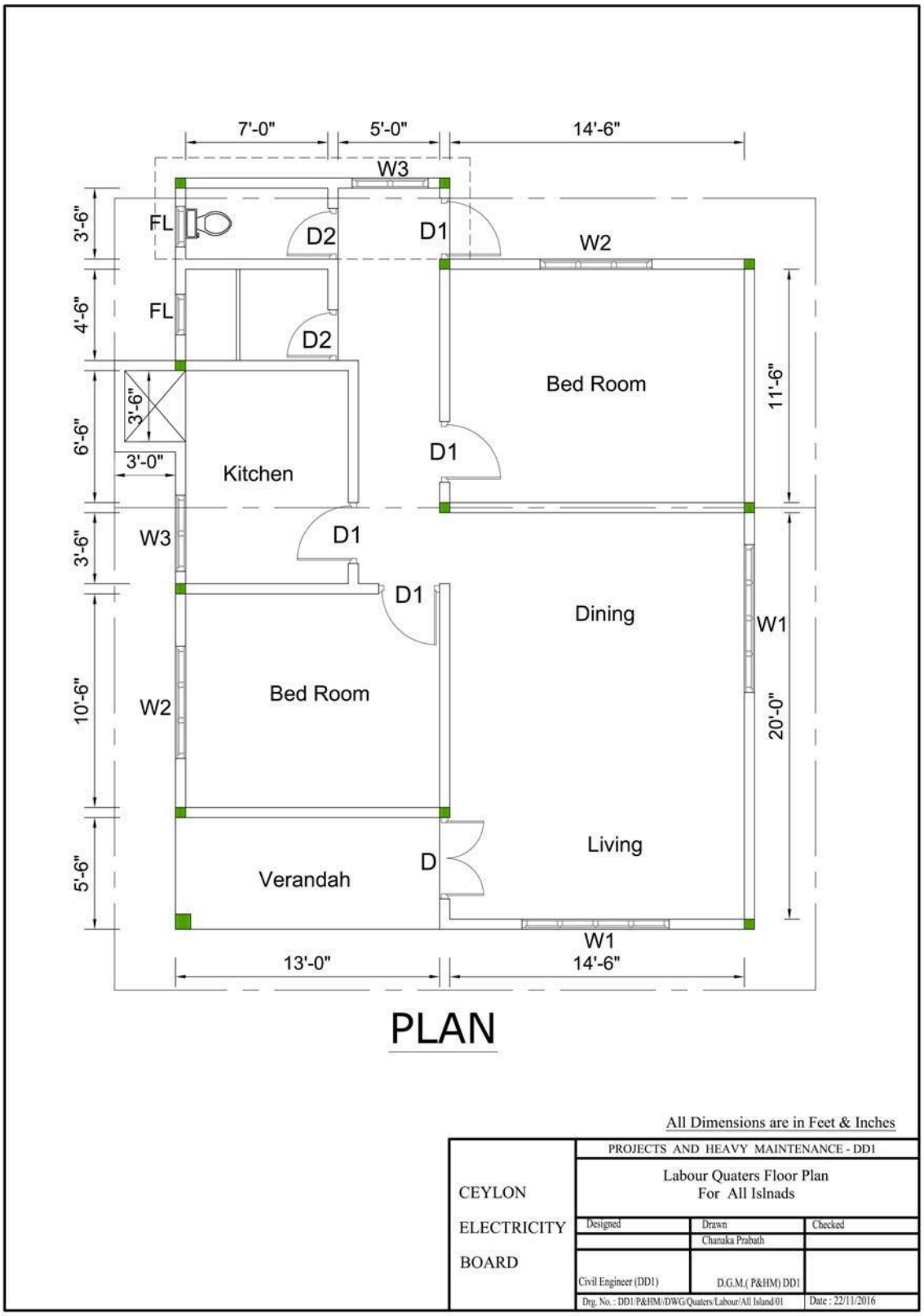


Figure C5: Plan for permanent Site Office for Labours

Annex C3: Layout of the Sites

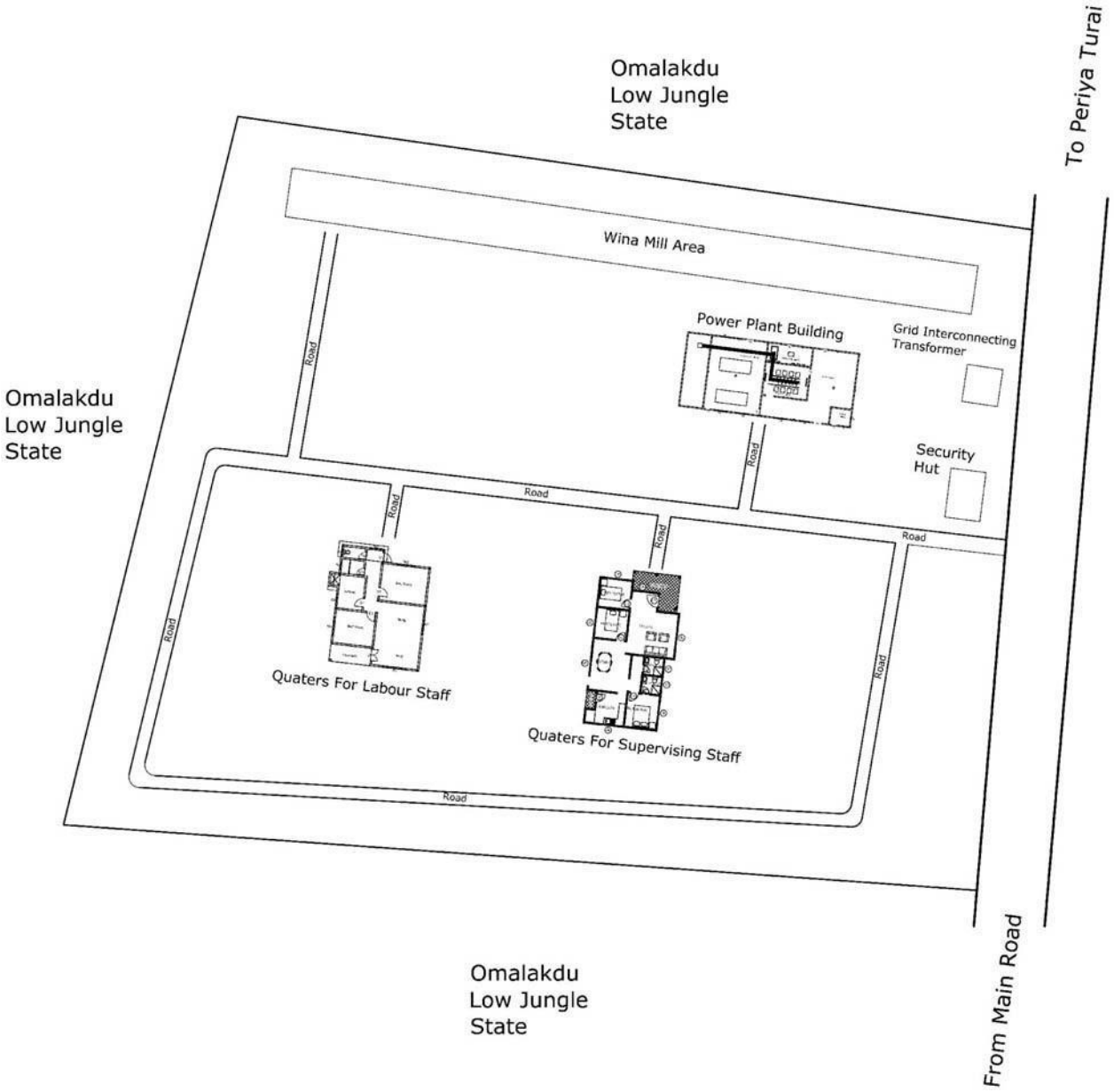


Figure C6: Layout of site at Delft

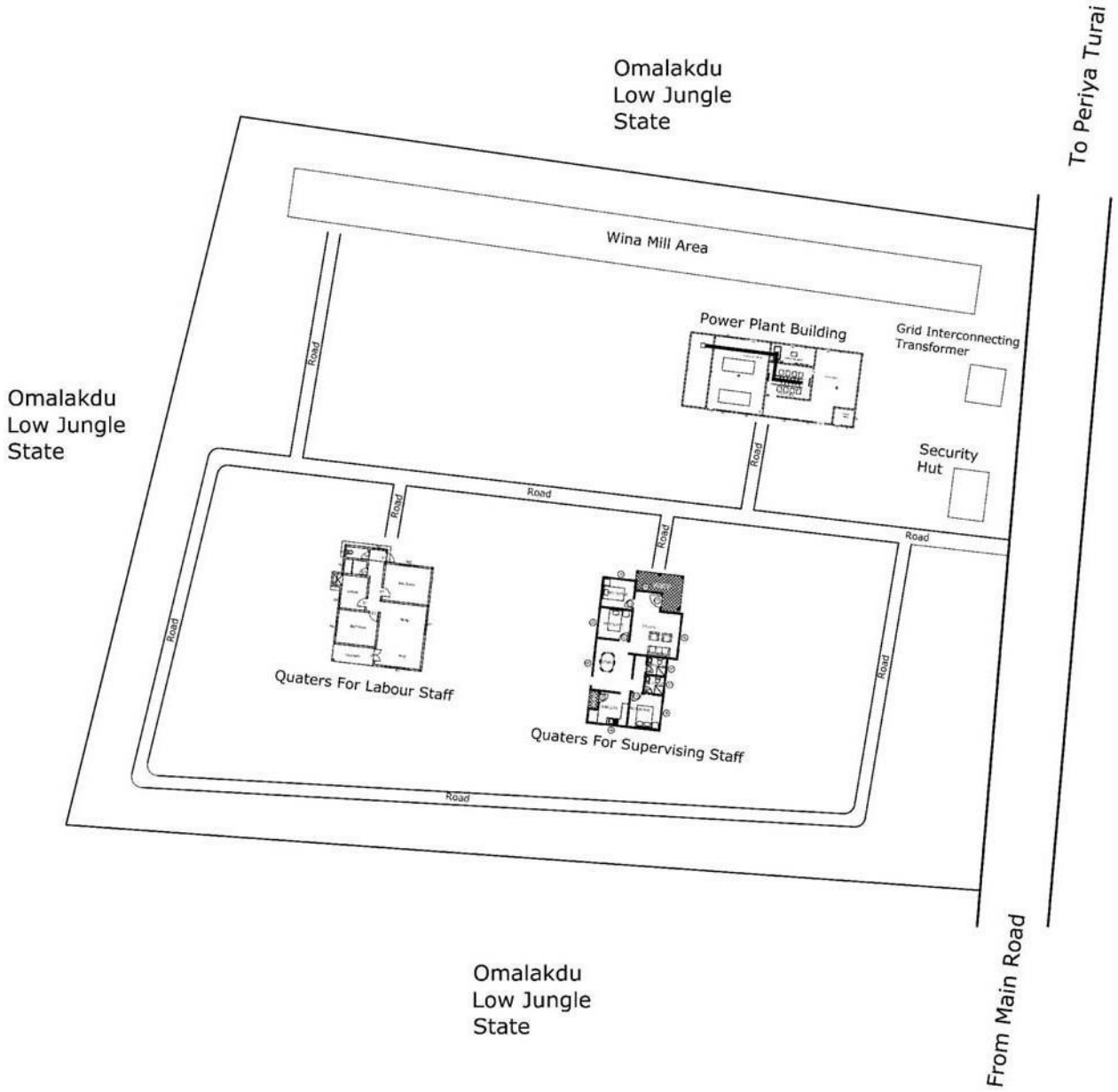


Figure C7: Layout of site at Nainativu

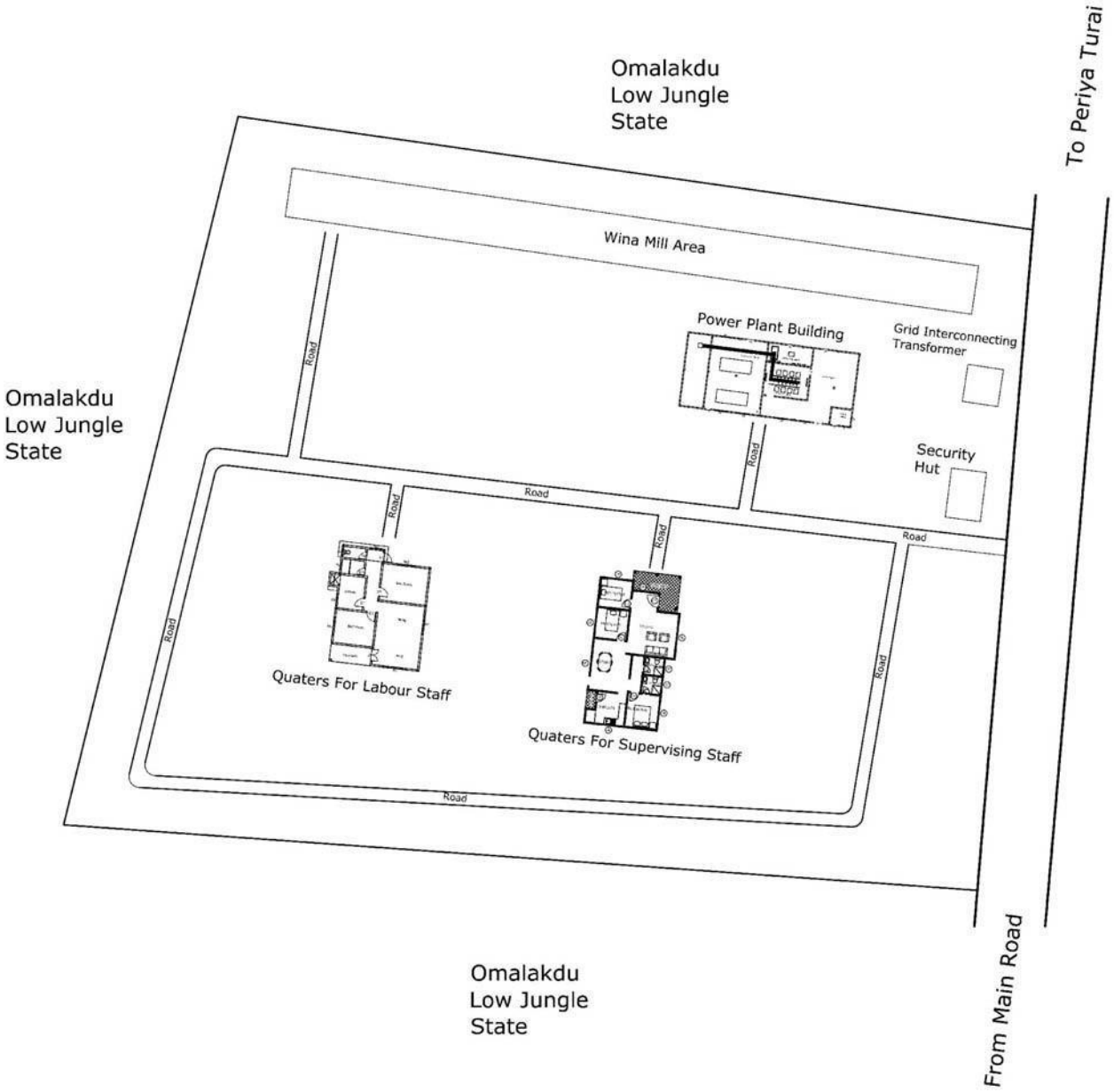


Figure C8: Layout of site at Analativu

Annex C4: Floors and Sections Arrangement of Power Plant Building

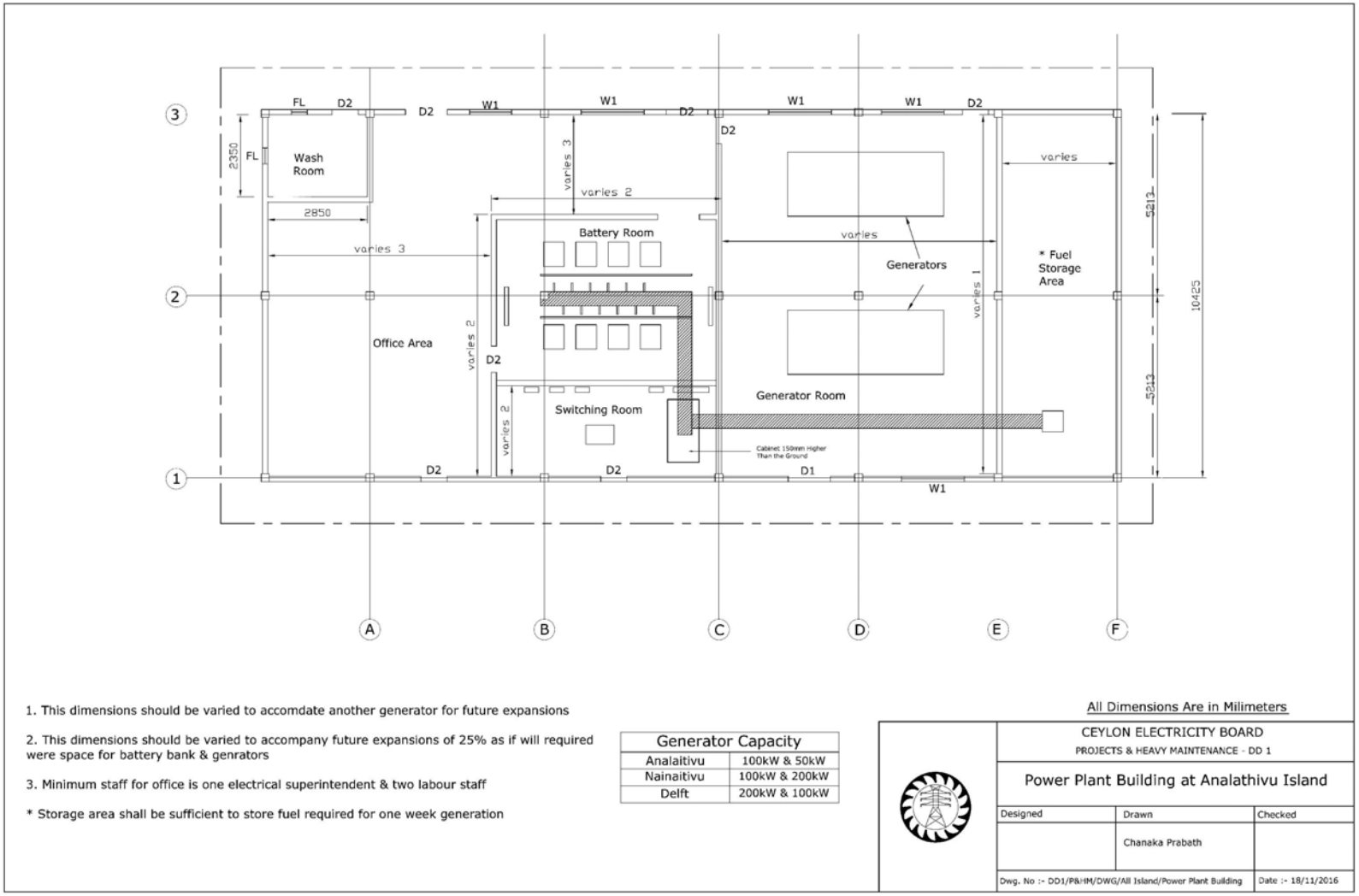


Figure C9: Floors and Sections Arrangement of Power Plant Building for Delft, Analativu and Nainativu

Annex C5: Details of Security Fence

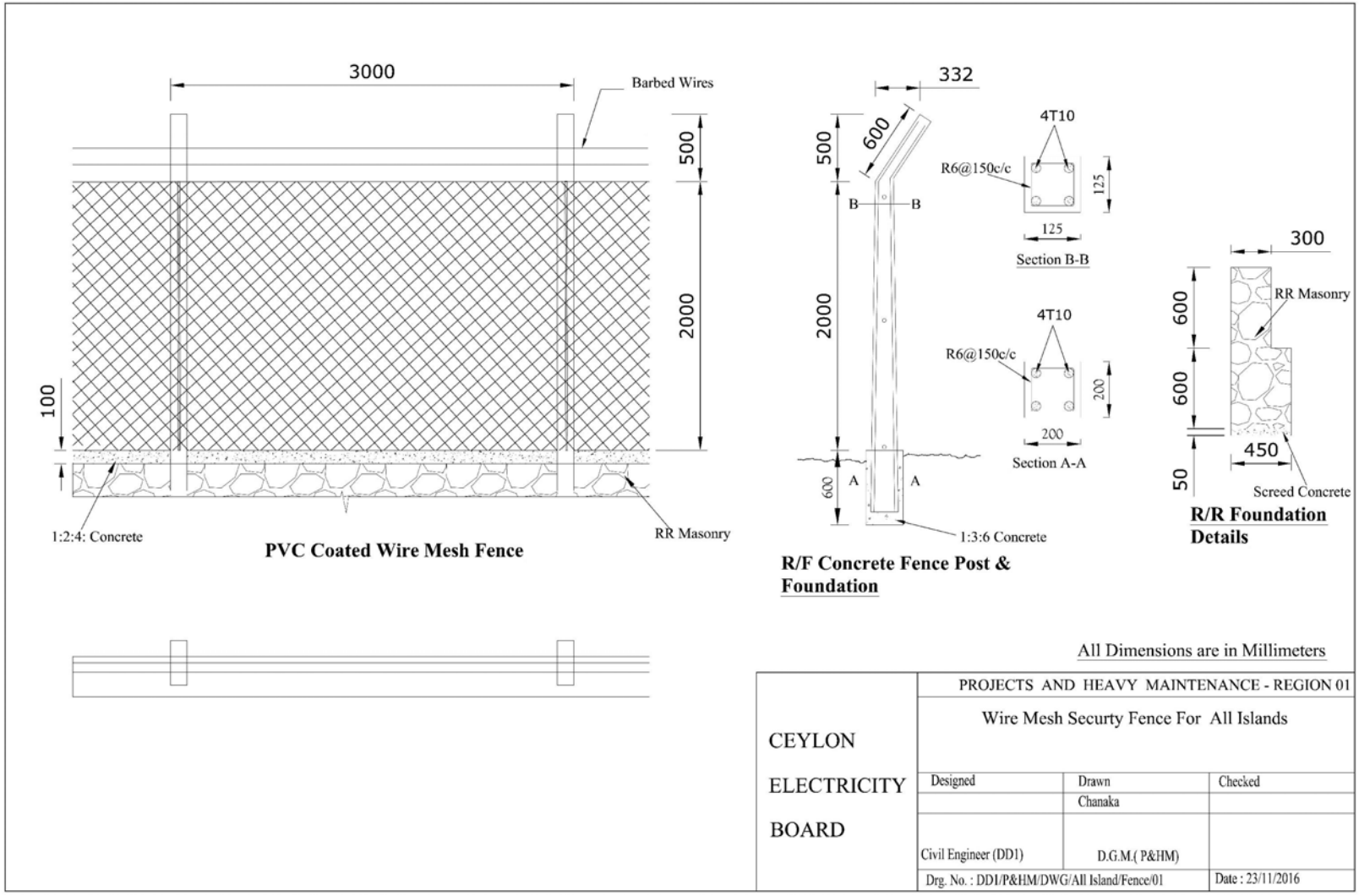


Figure C10: Details of Security Fence

Annex C6: The Layout of Double Leaf Gates at the Entrance to three Sites

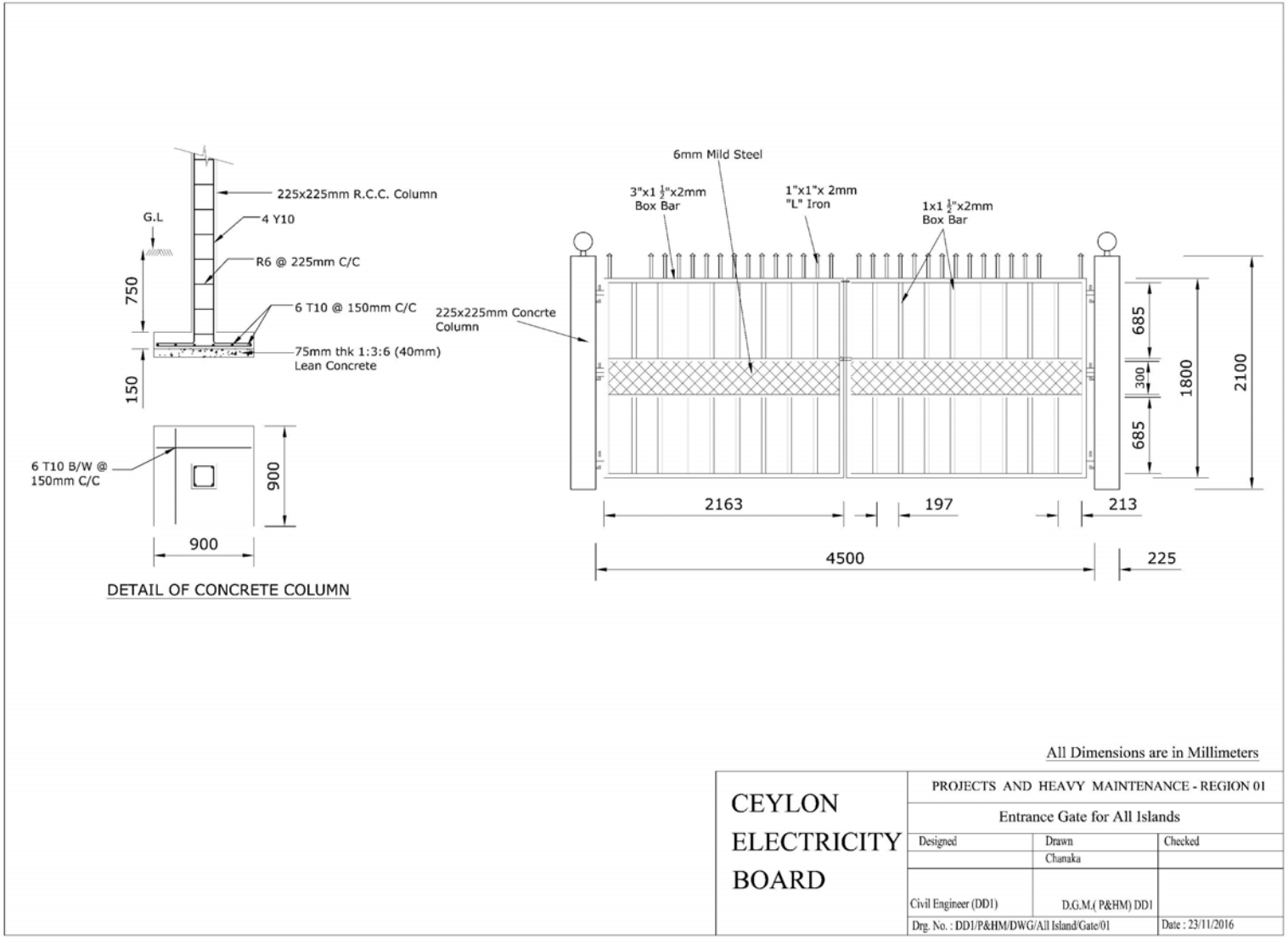


Figure C11: The Layout of Double Leaf Gates at the Entrance to three Sites

Annex C7: The List of Main Equipment

1. Photovoltaic modules
2. Supporting structures for PV modules
3. Photovoltaic inverters
4. PV array wiring junction box
5. Other accessories of PV system
6. Wind turbines
7. Towers for wind turbines
8. Converters for wind turbines
9. Dump loads for wind generators
10. Wind power inverters
11. Other accessories for wind generator system
12. Diesel generators
13. Other diesel generator elements
14. Batteries
15. Standalone DC/AC inverter(s)
16. Cluster switch box and accessories
17. Power plant controller
18. Earthing
19. Data acquisition, monitoring and controlling system
20. Equipment and Accessories for Grid Interconnection
21. Associated panel boards for DC & AC bus bars and volt, ampere and energy meters
22. System installation, associated works and services
23. Allied buildings for battery storage, diesel generator, charge controller, inverters and panel boards as well as for the living of O&M staff. The area of the building may adjusted depending on the layout of batteries in the battery room. The rooms for power electronics and living areas must be partitioned from battery room.
24. Associated and incidental civil works (land and site development, pathways, fencing, waste water disposal, conducting contour survey and soil testing, foundations)
25. Foundations
26. Any other equipment or construction requirement.
27. Weather Station

Annex C8: Name Boards for Sites

Figure C12: Name Board for the Plant at Delft

Figure C13: Name Board for the Plant at Nainativu

Figure C14: Name Board for the Plant at Analativu

Annex C9: Furniture List

Ref.	Description	Quantity
	Labor Quarters	
1.	Double Bed	3
2.	Single Bed	3
3.	3 seat chair	3
4.	2 seat chair	3
5.	Stool	3
6.	Table Chairs	18
7.	Table (6 Person)	3
8.	Cupboards (2 door)	6
9.	Wooden high back chairs	12
	Supervisory Staff Quarters	
1.	Double Bed	9
2.	Single Bed	9
3.	3 seat chair	3
4.	2 seat chair	3
5.	Stool	3
6.	Table Chairs	18
7.	Table (6 Person)	3
8.	Cupboards (2 door)	6
9.	Wooden high back chairs	18

Annex C10: Soil Test Reports of sites

GEOTECHNICAL SITE INVESTIGATION REPORT

ON

PROPOSED 30KW HYBRID POWER PLANT

AT

DELFT, ANALATHIVU AND NAINATHIVU ISLAND OF JAFFNA DISTRICT

FOR

CEYLON ELECTRICITY BOARD
NO.288, KANDY ROAD
KURUNEGALA

Report submitted
By

SOIL Matter (Pvt) Ltd
No: 70/517, Newcity Gardens
Ranmuthugala, Kadawatha.

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GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED 30 KW WIND TERBINE SYSTEM AT ANALATHIVU, DELFT AND NAINATHIVU ISLANDS.

1. INTRODUCTION

Ceylon Electricity Board proposes to construct new 30 kW Wind turbine plants at Analathivu, Delft and Nainathivu Islands. The Client advised MS Soilmatter (Pvt) Ltd to make a geotechnical investigation and prepare a recommendation report for foundation design.

The objective of this geotechnical investigation is to take subsurface soil and rock profiles from selected boreholes and analysis of soil and rock strength parameters. Boreholes locations were given by the Client.

2. SCOPE OF THE PROJECT

The main objective of the investigation is to evaluate the geological conditions and sub surface soil/ rock properties and geotechnical parameters.

Scope of the project consisted with following but not limited to,

a) Drilling in overburden down to bed rock
b) Continuous soil sampling with or without SPT
c) Drilling through weathered rock
d) Drilling through Moderately weathered rock
e) Drilling through Hard bed rock.

3. LOCATION

Figure 1 Proposed site for the hybrid power plant on Analaitivu Island

Figure 2 Proposed site for the hybrid power plant on Nainativu Island

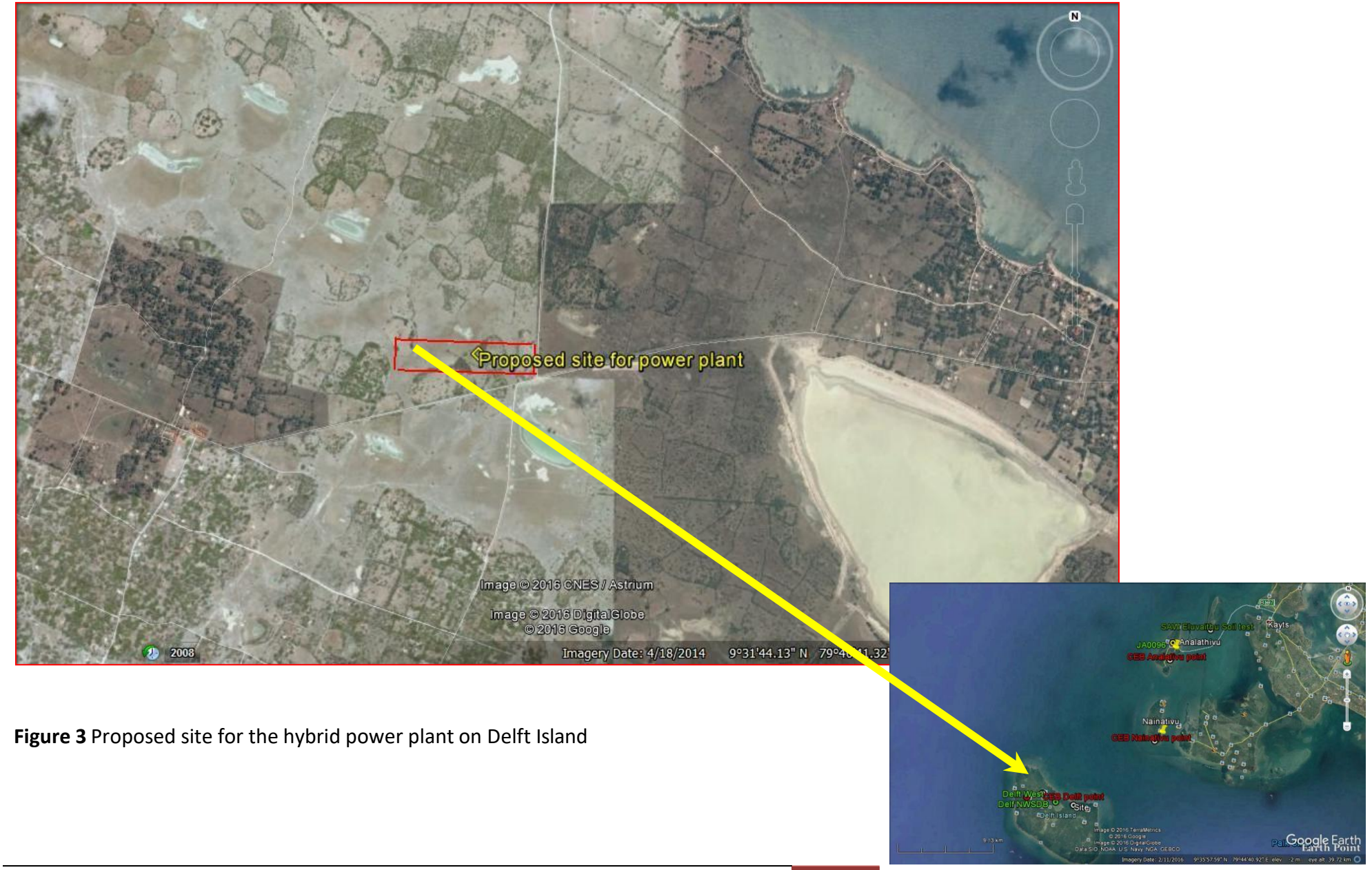


Figure 3 Proposed site for the hybrid power plant on Delft Island

The project sites are located at Analativu, Nainativu and Delft Islands and it is shown in above figure .The Islands are situated in Jaffna District. It requires nearly 11 km (45 min) sea journey from Kurikattuwan Jetty. Nainativu and Analativu Islands are comparatively 2-5 away from the Jetty.

3. FIELD INVESTIGATION

3.1 Drilling

Drilling and soil sampling was started on 09 November 2016 and continued up to14 November 2016.

A Geo-technical drill machines (YBM models made in Japan) were occupied for this investigation. Hydraulically operated drilling machine was used to advance the boreholes. Standard NX sized casings, NX rods, Drill bits, SPT hammer, double tube core barrels, and accessories were used to take soil and rock samples.

All the soil and rock samples recovered were numbered and packed in a wooded core box and transferred to laboratory for soil classification/ core logging and necessary laboratory analysis.

The static water table were measured after completion of boreholes.

At every one-meter, when and where necessary standard penetration test (SPTs) were carried out regularly in the overburden. This test was carried out as specified in BS: 1377. Disturbed samples of soil inclusive of those from the SPT tube were collected regularly.

All the equipment and test methods adopted in the borehole drilling are as per BS 5930 and BS 1377 standards.

Classifications of each soil samples were carried out. In the borehole log submitted, the classifications of soil types encountered along the depth of boreholes and the SPT values obtained are shown in annexure iv (Borehole logs).

Drilling consisted of advancing Three numbers of boreholes as given below.

Borehole ID	Final drilling depth (m)
Delft_ BH.01	10.00
Analathivu_BH.02	8.00
Nainathivu_BH.03	5.00

Drilling were advanced until firm rock formation and the bed rock is encountered. Each and every boreholes were supervised by a Drill Forman, jointly with Ceylon Electricity Board (CEB) representative at the site. Each boreholes advances up to bed rock level and bed rock drilling was performed as per the CEB advises.

Figure 4 SPT testing and Diamond Rock Core drilling is in progress at Delft

3.2 water table

The ground water table inside the boreholes was monitored, 6 hrs after the completion of boreholes. The depth to the ground water table in each borehole measured from existing ground level have been mentioned in borehole log sheets.

4.0 LABORATORY TESTING AND ANALYSIS

4.1 Core logging and sampling

The sub soil strata were recovered using a SPT tube split spoon sampler where necessary. Undisturbed samples were collected continuously. The soil samples were examined visually using a 10x magnifying glass and classified according to the unified soil classification system.
All the soil and rock samples were dispatched to Laboratory and soil/ Core logging were performed.

4.2 Rock sample testing

Unconfined Compressive Strength of rock samples were not tested due to the presence of cavity and limestone formation. However, CR and RQD values were obtained for strength analysis as per proposed method by Peck et. al. (1974)

5. PROPOSED STRUCTURAL DETAILS

Proposed structure will be a 30 m height wind power plant.
Rotor blade dimater-12.5 m
Rated wind speed- 10 m/s
Turbine weight - 1380 kg
Tower height - 30 m

6. RECOMMENDATIONS

Based on borehole logs in Annex iv, the subsurface across BH1, BH2 and BH3 can be modeled as shown in Table 1 to Table 3. The layers together with the thickness of each layer, and SPT-N value of each layer are depicted in Borehole logs.

Table 1 Subsurface Bearing capacity details across BH.01 (Delft_BH.01)

BH No	Position (m)	Layer description	Average SPT-N value	Allowable q_a (kN/m^2)
Delft_ BH.01	1.00 - 3.00	Clay with Weathered limestone	02	15
	3.00-4.30	Weathered limestone with Clay	04	20
	4.30-5.00	Hard limestone with Clay	18	120
	5.00-8.00	Hard Limestone with Clay	30	250
	8.0-9.30	Weathered limestone	40	300
	>9.30	Moderately weathered Hard rock	>50	350

Table 2 Subsurface Bearing capacity details across BH.02 (Analathivu_BH.02)

BH No	Position (m)	Layer description	Average SPT-N value	Allowable q_a (kN/m^2)
Analathivu_ BH.02	1.00 - 5.00	Weathered limestone with Clay	30	200
	5.00-7.60	Hard limestone with Clay	45	300
	>7.60	Moderately weathered Hard rock	>50	350

Table 3 Subsurface Bearing capacity details across BH.02 (Nainathivu_BH.03)

BH No	Position (m)	Layer description	Average SPT-N value	Allowable q_a (kN/m^2)
Nainathivu_ BH.03	1.00 - 1.50	Silty sandy gravel soil	12	75
	1.50-3.00	Hard limestone with minor cavities	N>50	500
	3.00-4.00	Hard limestone with minor cavities		
	4.00-5.00	Hard limestone with minor cavities		

Recommendation for Delft Islands

Soil profile is very weak up to -4.30 m depth from the existing ground level. This is due to highly decomposed limestone layer. Therefore, soil improvement will have to be done by excavating up to -4.30 m depth and filling with quarry dust/ sand mixing with cement up to the foundation level. Excavation diameter or width should be done 20 % more than the expected foundation diameter/ Width of a footing. An allowable bearing capacity of 100 kN/m^2 can be obtained after the ground improvement.

Alternative options such as precast or micro-piles will not be practical for this remote Island.

Recommendation for Analathivu Island

Based on above analysis, it is recommended to adopt individual pad foundation, which is placed at or below 2.0 m from the existing ground level, and design for an allowable bearing capacity of 200 kN/m^2.

Recommendation for Nainathivu Island

Allowable bearing capacity of shallow foundations on rocks can be determined based the RQD value, proposed by Peck et. al. (1974). Since, RQD value of rock samples is zero, allowable bearing capacity can be taken as 1 MPa. However, it was reported that CR is vary from lower value to higher values, which implies that there is a possibility of cavities within the limestone layer. Therefore, it is recommended to reduce the bearing capacity by 50%.

Based on above analysis, it is recommended to adopt individual pad foundation, which is placed at a depth of (1.8 - 2.0) m from the ground surface, and design for an allowable bearing capacity of 500 kN/m^2.

This kind of limestone formation contains minor to larger cavities and therefore uniform soil/ strata can not be generalized for all the footing location in this proposed structure.

Foundation should be constructed so as to avoid any uplifting pressure due to wind action imposed on the tower. Therefore, proper anchoring of the foundation into a hard bed rock will have to be adopted if uplifting load is significantly high.

Safe Bearing capacities have been mentioned for each boreholes in the above table and those could be used to design foundations for this structures. Special care and attention must be taken during foundation excavation for each and every footing to understand the soil condition by visual inspection. Qualified Engineer must be in the site during foundation excavation and if any loose or special formation is encountered, it is advisable to coordinate with MS Soilmatter for any kind of clarification.

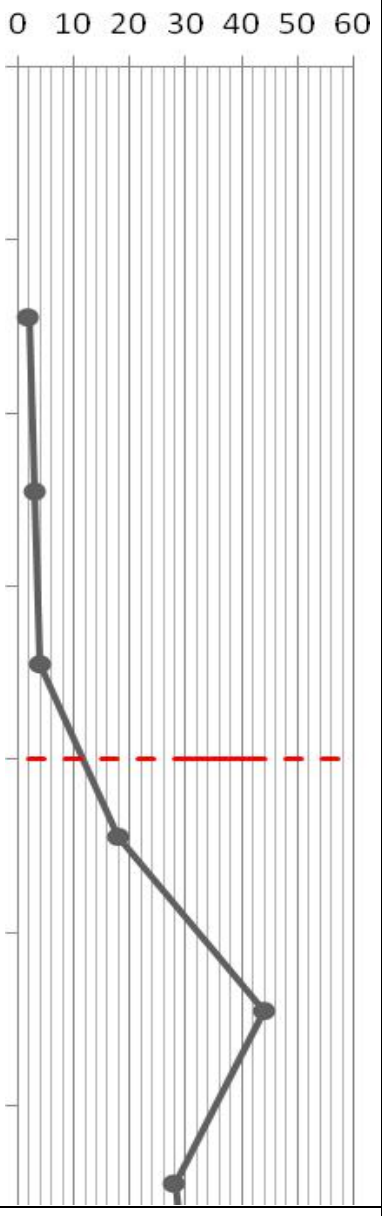
Report Prepared By
GEOLOGICAL ENGINEER
K. R. P. K. Herath B. Sc. (Geo), M. Phil (En.Sc.), MGS (SL), MAAG (Canada), MBA (Fin)

Annexure i Soil and rock sample pictures

Soilmatter
Geotechnology for Safe Living

Location	Delft Island of Jaffna District		
Project	30 kW Hybrid Energy	Client	Ceylon Electricity Board
Contractor			
Bore Hole#	BH.01	Starting date: -09/11/2016	Ending date: -11/11/2016

Classification of the Soil / Rock	Depth (m)	Legend	Soil Symbol	SPT "N" value	Water Level:- 4.0 m
Top soil. Pale ash to pale brown colored, silty sandy gravels with limestone pieces.	00.00			-	
Ash colored, weathered Miocene limestone. Clay	01.00			01 01 01 N=02	
Pale yellow with off white colored, weathered limestone rock. Clay with Hard Moderately weathered rock pieces (2 - 5 cm size).	02.00			01 01 02 N=03	
Ash with milky colored, Clay with limestone gravels (2-5 cm).	03.00			01 02 02 N=04	
No sample. Sample loss	04.00			03 06 12 N=18	
Ash with milky colored Clay with weathered limestone. Hard Miocene limestone layer.	05.00			12 14 30 N=44	
Clay with weathered limestone	06.00			11 14 14 N=28	



Sample/ Test key
MPS Medium Particle Size
CR Core Recovery (%)
HWR Highly Weathered Rock
MWR Moderately Weathered Rock
HB Hammer Bounced

Remarks:

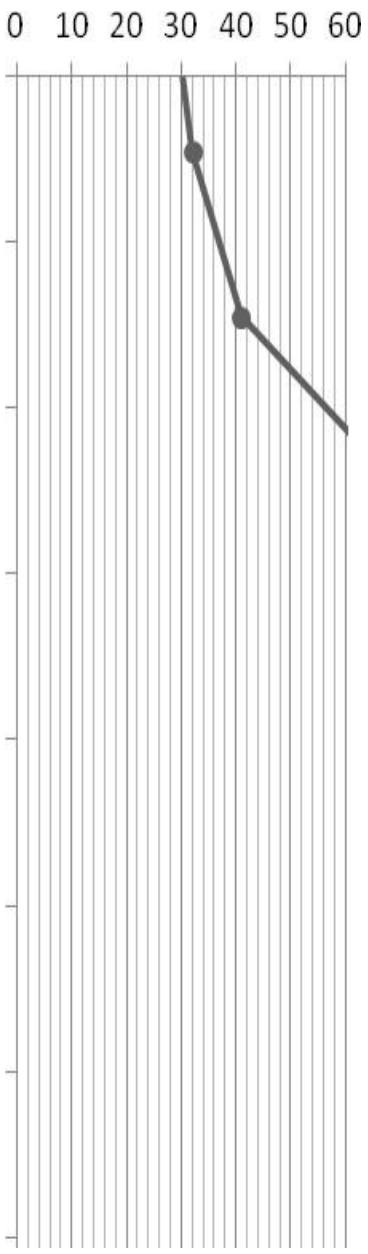
Logged By:
Kalana Harun

25/11/2016

Location	Delft Island of Jaffna District		
Project	30 kW Hybrid Energy	Client	Ceylon Electricity Board
Contractor			
Bore Hole#	BH.01 cont...	Starting date: -09/11/2016	Ending date: -11/11/2016

Classification of the Soil / Rock	Depth (m)	Legend	Soil Symbol	SPT "N" value
Ash colored, weathered Miocene limestone with Clay	07.00			13 15 17 N=32
Ash colored, weathered Miocene limestone with Clay	08.00			16 19 22 N=41
Ash colored, weathered rock. Hard Moderately weathered rock	09.00			24 29 HB N>50
Ash colored, Hard rock, Miocene limestone.	09.30			
Drilling terminated at 10.0 m	10.00			
	11.00			
	12.00			
	13.00			
	14.00			

Water Level:- 4.0 m



Sample/ Test key
MPS Medium Particle Size
CR Core Recovery (%)
HWR Highly Weathered Rock
MWR Moderately Weathered Rock
HB Hammer Bounced

Remarks:

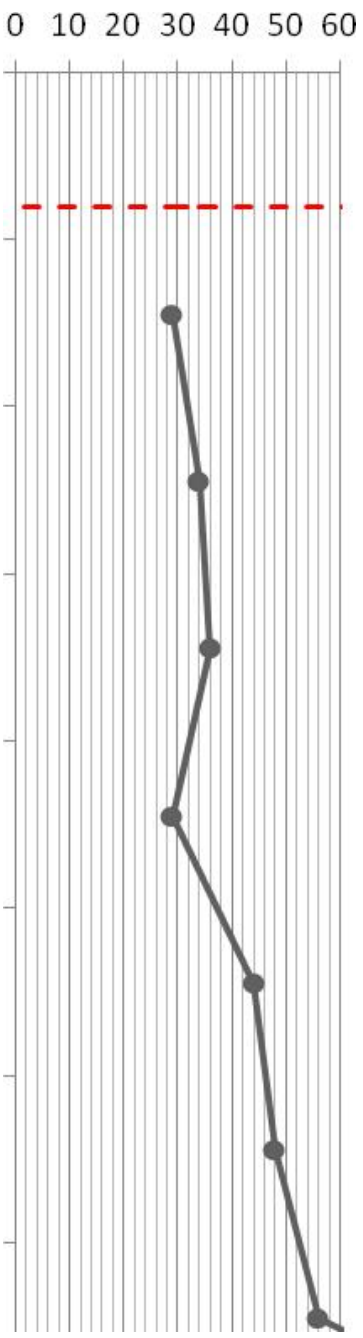
Logged By:
Kalana Harun

25/11/2016

Location	Analathivu Island of Jaffna District		
Project	30 kW Hybrid Energy	Client	Ceylon Electricity Board
Contractor			
Bore Hole#	BH.02	Starting date: -13/11/2016	Ending date: -14/11/2016

Classification of the Soil / Rock	Depth (m)	Legend	Soil Symbol	SPT "N" value
Top soil. Brown colored, Sandy silty soil	00.00			-
Milky colored, weathered Miocene limestone with Clay	01.00			11 12 17 N=29
	02.00			19 20 14 N=34
	03.00			17 17 19 N=36
	04.00			11 13 16 N=29
Off white colored, limestone with Clay	05.00			19 21 23 N=44
	06.00			21 22 26 N=48
Moderately weathered, Hard limestone. **Drilling terminated at 8.0 m**	07.00 07.60			26 27 29 N=56

Water Level:- 0.80 m



Sample/ Test key
MPS Medium Particle Size
CR Core Recovery (%)
HWR Highly Weathered Rock
MWR Moderately Weathered Rock
HB Hammer Bounced

Remarks:

Logged By:
Kalana Harun

25/11/2016

Location	Nainathivu Island of Jaffna District		
Project	30 kW Hybrid Energy	Client	Ceylon Electricity Board
Contractor			
Bore Hole#	BH.03	Starting date: -12/11/2016	Ending date: -12/11/2016

Classification of the Soil / Rock	Depth (m)	Legend	Soil Symbol	SPT "N" value	Water Level:- 2.2 m
Top soil. milky colored, weathered limestone. silty sandy type soil.	00.00			-	
Silty sandy gravel. 1-2 cm size limestone pieces.	01.00			06 07 32HB N>50	
Milky colored, hard limestone	01.50				Core run- 1.50-3.0 m CR-20 % RQD- Nil
	02.00				
Milky colored, hard limestone	03.00				Core run- 3.0-4.0 m CR-40 % RQD- Nil
	04.00				Core run- 4.0-5.0 m CR-50 % RQD- Nil
Off white with pale brown colored, limestone	05.00				
Drilling terminated at 5.0 m	06.00				
	07.00				

Sample/ Test key **MPS** Medium Particle Size **CR** Core Recovery (%) **HWR** Highly Weathered Rock **MWR** Moderately Weathered Rock **HB** Hammer Bounced	Remarks:	Logged By: *Kalana Harun* *25/11/2016*

Part D - Supplementary Information

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Notes on Schedules

The schedules are intended to provide the Employer with essential supplementary information in an organized format. The examples of more commonly used schedules are given herein. Others may be devised and added in accordance with the requirements of the instructions to bidders.

All the schedules are essential for the bid evaluation and some in contract execution; they should all be incorporated in the contract, and appropriate changes introduced with the approval of the employer or its representative.

The schedules are to be completed and submitted as part of the technical proposal in accordance with the instruction to bidders.

There shall be no equipment offered without filling these schedules. These sheets to be copied and filled in separately for each different type of equipment offered.

1. Manufacturer and Places of Manufacture, Testing and Inspection

1.1 Manufacturers and Places of Manufacture, Testing and Inspection of Material for Wind, Solar and Diesel Hybrid System

Item	Manufacturer & Place of Manufacture	Place of Testing & Inspection
1. Photovoltaic modules 2. Supporting structures for PV modules 3. Photovoltaic inverters 4. PV array wiring junction box 5. Other accessories of PV system 6. Wind turbines 7. Towers for wind turbines 8. Converters for wind turbines 9. Dump loads for wind generators 10. Wind power inverters 11. Other accessories for wind generator system 12. Diesel generators 13. Other diesel generator elements 14. Batteries 15. Standalone DC/AC inverter(s) 16. Cluster switch box and accessories 17. Power plant controller 18. Data acquisition and monitoring and controlling system 19. Inter-connection cables 20. Associated panel boards for DC & AC bus bars and volt, ampere and energy meters		

Note: Only one manufacturer should be indicated against each item

2. Schedule of Guaranteed Technical Particulars

The bidder is required to fill the spaces in these schedules

2.1 Schedule of Guaranteed Technical Particulars for PV Panels, Inverters and Accessories

Ref.	Description		Offered	Comments
	PV Panels			
	Proposed Capacities for three Islands			
	Manufacturer			
	Country of Origin			
	Model			
	Cell Type			
	International Standard Followed for Manufacturing PV Modules			
	Maximum Power of a PV Module at STC Conditions (Pmax)	W		
	Power Tolerance at STC	%		
	Number of PV Modules for an Array	Nos.		
	Voltage at Pmax (Vmp)	V		
	Current at Pmax (Imp)	A		
	Open Circuit Voltage (Voc)	V		
	Short Circuit current (Isc)	A		
	Maximum System Voltage	V		
	Operating Temperature	C		
	Temperature Coefficient of Pmax	%/C		
	Maximum Temperature coefficient of Voc	%/C		
	Temperature coefficient of Isc	%/C		
	Module Dimension (LxWxH)	mm		
	Maximum Weight of a PV Panel	kg		
	Maximum Series Fuse for an Array	A		
	Minimum SPV Module Conversion Efficiency under STC (Standard Test Condition)	%		
	Designed Wind Load	Pa		
	Is Neutral Terminal Earthing is Required?	Yes/No		
	Is Front Cover Construction Anti-reflective Coated, Textured White Tempered Glass	Yes/No		
	Whether a Certified Copy of an ISO 9001:2008 and ISO 14001 are attached?	Yes/No		
	is the quality plan attached?	Yes/No		
	is a copy of the international certification to the European union is attached ?	Yes/No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes/No		

Junction Box				
	Junction Box Protection Class			
	Connector Type			
	Safety Class in accordance with IEC 61140			
	Fire Rating			
	Whether PV Panels are Suitable to be Installed at the Close Proximity of the Sea?	Yes/No		
	Whether a Copy of the Certificate of Module for Conformity with IEC 61730 Part I and II for Safety Qualification Testing or Equivalent is Provided?	Yes/No		
	Whether the Quality Control Plan of the manufacturing process is attached.	Yes/No		
	Whether the Module Surface Consist of Impact Resistant, Low-iron and High-transmission Toughened Glass?	Yes/No		
	Material of the Module Frame			
	Whether a Junction Box Provide in accordance with Clause 2.2 (f)?	Yes/No		
	Whether Necessary I-V curves at 250C, 450C, 600C and at NOC are Furnished?	Yes/No		
	PV Module Replacement Guarantee Against Material Defect or Craftsmanship			
	Maximum Weight of a PV Panel	kg		
	Maximum Temperature Coefficient for the Generation Loss	% / °C		
	Whether all the Panels are Provided an Identification Tag?	Yes/No		
	Whether Salt mist corrosion test report as IEC 61 701 is Provided?			
	Whether Ammonia corrosion test report as IEC 62716 is Provided?	Yes/No		
	Is a copy of ISO 9001:2008 certificate is attached.	Yes/No		
	Supplier's experience in years in manufacturing the bidding item	Yes/No		
	is a copy of the international certification to the European union is attached	Yes/No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes/No		
Mounting Structure				
	Manufacturer			
	Model			
	Country of Origin			
	Material of the Module Structure?			
	Whether the Structural Material is Corrosion Resistant and Electrolytically Compatible with the Materials used in the Module Frame, its Fasteners, Nuts and Bolts?	Yes/No		
	Whether the Structure have a Provision to Adjust its Angle of Inclination to the Horizontal as per the Site Conditions ?	Yes/No		
	Maximum Withstanding Wind Load on the Structure?			
	Grouting Material for SPV Structure?			
	Whether the Supplier Agree with the Conditions in Clause 2.4 (f)?	Yes/No		
Solar Inverter				
	Manufacturer			
	Country of Origin			

	Model			
	DC input			
	Maximum DC input voltage	V		
	MPPT voltage Range	V		
	No of independent MPP inputs	nos		
	Rated input voltage	V		
	minimum input voltage	V		
	maximum DC power	W		
	AC output			
	Rated grid voltage (single phase /Three phase)	V		
	Rated Output Frequency	Hz		
	Operating range of AC power frequency	Hz		
	rated Power of an Inverter	kW		
	Power factor			
	Number of Inverters for the Proposed System	Nos.		
	Modulation technique of the Inverter			
	Rated Output Voltage	V		
	Maximum output current	A		
	Does it comply with connecting to 3ph 4 wire TT distribution grid	Yes/No		
	Nominal AC current	A		
	Maximum output fault current	A		
	Total Harmonic Distortion	%		
	Over voltage category in accordance with IEC 60664-1			
	Efficiency	%		
	General			
	Maximum efficiency	%		
	Weight	kg		
	size (WxHxD)	mm		
	Climatic category according to IEC 30721-3			
	Environmental category (indoor/outdoor)			
	Operating temperature Range	°C		
	Maximum permissible relative humidity value	%		
	Noise level	dB		
	Cooling method			
	Protection class according to IEC 62103			
	Degree of protection for electronic according to IEC 60529			
	topology			
	Whether Following Features and Protections are Provided?			
	DC reverse polarity protection	Yes/No		
	DC overvoltage protection	Yes/No		
	Mains (Grid) over-under voltage protection	Yes/No		
	Mains (Grid) over-under frequency protection	Yes/No		
	Fool proof protection against Islanding.	Yes/No		
	Protection against reverse currents	Yes/No		
	All pole sensitive residual current monitoring device should be available for trasformerless Inverter	Yes/No		

	PV Array ground fault detection.	Yes/No		
	Availability of LCD and piezoelectric keypad operator interface with Menu driven	Yes/No		
	Availability of Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.	Yes/No		
	Compatibility with battery and grid forming inverter	Yes/No		
	Compatibility with proposed monitoring system	Yes/No		
	Over load capacity (for 10 sec) should be 200% of continuous rating.	Yes/No		
	Whether the Inverter comply with IEEE 1547?	Yes/No		
	Whether the Inverter is Capable of withstanding an Unbalanced Output Load to the Extent of 30 %?	Yes/No		
	Whether Self Protective and Self-Diagnostic Features in accordance with Clause 2.4 (d) ?	Yes/No		
	Whether the Inverter Automatically Go to Shutdown/Standby Modes and Restart as Described in Clause 2.4 (e) ?	Yes/No		
	Compliance in Accordance with Clause 5.4 (h)?	Yes/No		
	Whether the Inverter withstand High Voltage Test in accordance with Clause 2.4 (i)?	Yes/No		
	Whether the Full Protection against Accidental Open Circuit and Reverse Polarity at the Input Provided?	Yes/No		
	Compliance in Accordance with Clause 2.4 (k)?	Yes/No		
	Whether Galvanic Isolation is Provide when Inverter is selected with a Transformer in accordance with Clause 2.4 (n)-(ii) Provided?	Yes/No		
	Warranty Period of the Inverter?	Years		
	manufacturing experience in years	Years		
	Is a copy of ISO 9001:2008 certificate is attached.	Yes/No		
	is the quality plan attached	Yes/No		
	is a copy of the international certification to the European union is attached	Yes/No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes/No		

2.2 Schedule of Guaranteed Technical Particulars for Diesel Generator and Accessories

Ref.	Description		Gen1	Gen2	Gen3	Gen4	Comments
	Generator Prime Capacity (kW / kVA)						
	Manufacturer						
	Model						
	Country of Origin						
	Rated Frequency	Hz					
	Rated voltage	V					
	Rated current	A					
	Electrical Efficiency	%					
	Rated Speed	rpm					
	Rated Power Factor						
	Fuel						
	Lube oil type						

	Connecting Type (three phase, four wire TT system)						
	Cooling System						
	Ingress Protection Grade	IP					
	Method of Starting						
	Method of Air Intake						
	Manufacturing Standards						
	Electrical Parameters						
	Wave distortion	%					
	Voltage fluctuation	%					
	Voltage / frequency fluctuation	%					
	AVR self-regulated, voltage regulation rate	%					
	Radio interference restraining accords with stipulation of VDE0875-N and ISO8528						
	Overall dimensions (with sound proof canopy)						
	Gross weight (with sound proof canopy)	kg					
	Sound level (with sound proof canopy)	dB					
	Engine						
	Rated Power	kW					
	Engine structure: vertical in-line, 4 stroke, turbo charged, air-to-air intercooled, direct injection						
	Aspiration						
	Fuel						
	Fuel Consumption						
	Lube Oil Type						
	Lube Oil Replacement Duration						
	Fuel System						
	Speed governing						
	Starting mode						
	Alternator						
	Alternator type						
	Voltage control & excitation						
	Protection Class						
	Insulation class						
	Steady voltage regulation	%					
	Instant voltage regulation	%					
	Voltage regulation scope	%					
	Power factor						
	Connection type						
	Starting mode						
	Other						
	Compliance with Clause 2.2 (e)	Yes / No					
	Compliance with Clause 2.2 (f)	Yes / No					
	Availability of the following items in Control Panel						
	Emergency Stop Button	Yes / No					

	Meters of Control Panel						
	Frequency Meter	Yes / No					
	Voltmeter and Sector Switch	Yes / No					
	Ammeter and Sector Switch	Yes / No					
	Gen Set kVA	Yes / No					
	Gen Set kW	Yes / No					
	Output Capacity	Yes / No					
	Output kwh	Yes / No					
	Power Factor	Yes / No					
	Hour Run Meter	Yes / No					
	Key Start, Shut Down and Auto Start, Shut Down Facility	Yes / No					
	NFPA 110 - Level 1 Compliance	Yes/No					
	Availability of self-monitoring and warning system	Yes/No					
	Availability of automatic synchronizing facility	Yes/No					
	Is this compatible with monitoring and controlling system	Yes/No					
	Is drop adjustable between 3%-5% in parallel operation	Yes/No					
	Availability of fuel tank sufficient for 24 h operation	Yes/No					
	Availability of 4P circuit breaker for switching	Yes/No					
	Full protection against reverse power shall be provided	Yes/No					
	Availability of CIP protection	Yes/No					
	Compatibility with battery and grid forming inverters	Yes/No					
	Warranty for a Period of 10 years Shall be Provided	Yes/No					
	manufacturing experience in years	Yes/No					
	Is a copy of ISO 9001:2008 certificate is attached.	Yes/No					
	is the quality plan attached	Yes/No					
	is a copy of the international certification to the European union is attached	Yes/No					
	Whether the Copies of Routine and Type Test Reports Provided?	Yes/No					

2.3 Schedule of Guaranteed Technical Particulars for Battery Bank, Grid Forming Inverters and Accessories

Ref.	Description		Offered	Comments
	Battery Bank			
	Proposed Battery Bank Capacities for Islands [kWh (kW)]			
	Manufacturer			
	Model			
	Country of Origin			
	Capacity of a Battery and Number of Batteries	kWh (kW)		
	Battery Type (Li-ion, maintenance free, sealed, rechargeable batteries)			
	Lifetime of the Batteries at 80% DoD	Cycles		
	Expected Colander Lifetime	20 Years		
	Ingress Protection Rating of Enclosure	IP		
	Rated Voltage of a Cluster	V		
	Maximum Charging/Discharging temperature	°C		
	Warranty Period (Fair Value)	7 Years		
	Whether the offered batteries are compatible with selected grid forming inverters	Yes/No		
	Whether it Possible to Add New Batteries to Increase the Capacity in Future for Expansion?	Yes/No		
	Whether the Technical Support is available throughout the Battery Lifetime (20 Years)?	Yes/No		
	Whether Fuses are available between Battery and Inverter?	Yes/No		
	Whether the BMS is Capable of Monitoring the following parameters:	Yes/No		
	cell and pack voltage	Yes/No		
	ambient and cell temperature	Yes/No		
	current	Yes/No		
	determination of State Of Charge	Yes/No		
	Whether BMS is incorporated the following facilities			
	Over/under voltage indication			
	over temperature protection	Yes/No		
	passive battery balancing facility			
	Facility available at battery to indicate battery fully charged or battery low conduction			
	Performance Guarantee	7 Years		
	Minimum Charging Efficiency	%		
	Whether Battery Unit Perform Satisfactorily in Humidity up to 100% with Temperature Between – 10C to + 65C?	Yes/No		
	Whether the battery disposal arrangement is attached.	Yes/No		
	Battery weight	kg		

	battery dimension (LxWxH)	mm		
	manufacturing experience in years			
	Is a copy of ISO 9001:2008 certificate is attached.			
	is the quality plan attached			
	is a copy of the international certification to the European union is attached			
	Whether the Copies of Routine and Type Test Reports Provided?			
	Grid Forming Inverters			
	Manufacturer			
	Model			
	Country of Origin			
	Connecting Type			
	Rated Power of an Inverter	kW		
	Number of Inverters for the Proposed System	Nos.		
	Rated grid voltage	V		
	Rated frequency	Hz		
	Frequency fluctuation limit	Hz		
	Rated current	A		
	Is Bi directional power flow possible	Yes/No		
	is the inverter Grid Integrated type	Yes/No		
	is compatible with Grid configuration (TT, 3 phase 4 wire system)?	Yes/No		
	is inverter compatible with batteries	Yes/No		
	Power Factor			
	Total Harmonic Distortion	%		
	Short circuit rating	kA		
	Minimum efficiency	%		
	External diesel generator connection specification			
	Maximum power in off grid	kW		
	Maximum current in off grid	A		
	Rated voltage	V		
	Rated Frequency	Hz		
	Maximum Inrush Current for 10ms	A		
	DC connection for battery specification			
	Rated input voltage	V		
	voltage range			
	Rated charging current	A		
	Rated discharging current	A		
	maximum battery charging current	A		
	Battery Capacity Range	kW		
	Recommended Minimum Battery Capacity (C10) in Off grid System	kW		
	Standby consumption	W		
	General specification			

	Climatic Category according to IEC 30721-3-3			
	Degree of protection in accordance with IEC 60529			
	protection class in accordance with IEC 62103			
	Operating temperature range	°C		
	Power factor			
	Noise emission	dB(A)		
	Humidity	%		
	Over Voltage Category in accordance with IEC 60664-1			
	Topology			
	Environmental Category (Indoor)			
	Cooling method			
	Whether Following Features and Protections are Provided?			
	Short circuit protection	Yes/No		
	AC overload protection	Yes/No		
	DC reverse polarity protection	Yes/No		
	Over temperature protection	Yes/No		
	Battery deep discharge	Yes/No		
	no of multifunction relays available	Yes/No		
	is connection available for battery sensor	Yes/No		
	Whether the Inverter is Capable of Managing a standalone three phase grid based on Li-Ion/LFP Li-Ion/LFP battery power, with additional decentralized AC coupled power sources like wind generators and PV plants and a central genet?	Yes/No		
	Whether the Inverter Complies with the Requirements Defined in IEEE 1547 for ensuring the stable standalone grid with voltage and frequency fluctuations within the acceptable limits?	Yes/No		
	is inverter compatibility with Batteries	Yes/No		
	Whether the Inverter is Equipped with the Programmable Load Control Facility Including Selected Load Shedding?	Yes/No		
	Whether the Ability of Programming Parameters such as Power Output, Charging and Discharging Currents, Threshold of Battery Voltage and Times of Operations?	Yes/No		
	Whether Inverters Fulfil All Requirements for an Operation in Tropical Climates and Sea Water Atmosphere?	Yes/No		
	Warranty Period	10 Years		
	Whether Display of the Inverter Comply with Clause 4.3 (l)?	Yes/No		
	Whether the Inverter Support Remote Monitoring and Controlling with a Compatible Communication Protocols (with networking facilities) ?	Yes/No		
	inverter weight	kg		
	inverter dimension (LxWxH)	mm		
	manufacturing experience in years			
	Is a copy of ISO 9001:2008 certificate is attached.			
	is the quality plan attached			

	is a copy of the international certification to the European union is attached			
	Whether the Copies of Routine and Type Test Reports Provided?			

2.4 Schedule of Guaranteed Technical Particulars for Wind Generator, Inverter and Accessories

Ref.	Description		Offered			Comments
	Proposed Wind Generator Capacities		50 kW	100 kW	120 kW	
	Wind Generator					
	Manufacturer					
	Model					
	Country of Origin					
	Number of Wind Turbines and Capacity of Each					
	Generator Type					
	rated Output Voltage of the Generator					
	Applicable Standards					
	Insulation Class					
	Whether the Horizontal Axis, 3-blade rotor, one?	Yes /No				
	Operating Temperature Range of WTG ?					
	Cut in Speed of WTG?	m/s				
	Survival Wind Speed of WTG ?	m/s				
	rotor diameter	m				
	mounting height	m				
	Power control method					
	Construction and Material of Wind Blades?					
	Whether the WTG a Direct Transmission Type?	Yes /No				
	Maximum Noise Level measured in Accordance with IEC 61400-1					
	Whether the Copies of Routine and Type Test Reports Provided?	Yes /No				
	Whether the Enclosures uv resistant and corrosion resistant					
	type of Breaking System to Prevent Uncontrolled Rotation					
	Whether Protection Against Following Provided?	Yes /No				
	Short Circuit?	Yes /No				
	Earth Fault?	Yes /No				
	Over Load?	Yes /No				
	Over and Under-Voltage?	Yes /No				
	Whether the Wind speed curves provided according to IEC 61400-12	Yes /No				
	Life Span of Continuous Operation	Years				
	Warranty Period	Years				

	gross weight	kg		
	package size when delivering (LxWxH)	mm		
	Is a copy of ISO 9001:2008 certificate is attached.	Yes /No		
	is the quality plan attached	Yes /No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes /No		
	Wind Turbine Mounting Structure			
	Manufacturer			
	Model			
	Country of Origin			
	Type of Mounting Structure	Tower, Lattes, ect		
	Type of Foundation	Screw, Concrete		
	Whether Galvanizing of Steel Parts are Sufficient for Category C4 of ISO 9223?			
	Whether Following Installation Details are Provided with the Offer;			
	Design details and drawings of foundations?	Yes /No		
	Structure installation details and drawings?	Yes /No		
	Electrical grounding details (earthling)?	Yes /No		
	Name any special machineries are to be used in construction stage?	Yes /No		
	Galvanizing test reports for foundation screws	Yes /No		
	Weight of the package for one generator	kg		
	Size of the package for one generator (LxWxH)	mm		
	Is a copy of ISO 9001:2008 certificate is attached.	Yes /No		
	is the quality plan attached	Yes /No		
	is a copy of the international certification to the European union is attached	Yes /No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes /No		
	Rectifier, Inverter and Dump Load System			
	Manufacturer			
	Country of Origin			
	Model			
	AC input			
	Maximum AC input voltage	V		
	AC input range	V		
	AC frequency range	Hz		
	MPPT voltage Range	V		

	No, of independent MPP inputs	nos		
	Rated input voltage	V		
	minimum input voltage	V		
	maximum AC power	W		
	AC output			
	Rated grid voltage (singhe ph/Three phase)	V		
	Rated Output Frequency	Hz		
	Operating range of AC power frequency	Hz		
	rated Power of an Inverter	kW		
	Power factor			
	Number of Inverters for the Proposed System	Nos.		
	Modulation technique of the Inverter			
	Rated Output Voltage	V		
	Maximum output current	A		
	Does it comply with connecting to 3ph 4 wire TT distribution grid	Yes /No		
	Nominal AC current	A		
	Maximum output fault current	A		
	Total Harmonic Distortion	%		
	Over voltage category in accordance with IEC 60664-1			
	Efficiency	%		
	General			
	Maximum efficiency	%		
	Weight	kg		
	size (WxHxD)	mm		
	Climatic category according to IEC 30721-3			
	Environmental category (indoor/outdoor)			
	Operating temperature Range	°C		
	Maximum permissible relative humidity value	%		
	Noise level	dB		
	Cooling method			
	Protection class according to IEC 62103			
	Degree of protection for electronic according to IEC 60529			
	topology			
	Whether Following Features and Protections are Provided?			
	AC overvoltage protection	Yes /No		
	Mains (Grid) over-under voltage protection	Yes /No		
	Mains (Grid) over-under frequency protection	Yes /No		
	Fool proof protection against Islanding.	Yes /No		
	Protection against reverse currents	Yes /No		
	All pole sensitive residual current monitoring device should be available for trasformerless Inverter	Yes /No		
	Availability of LCD and piezoelectric keypad operator interface with Menu driven	Yes /No		

	Availability of Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.	Yes /No		
	Compatibility to work with battery and grid forming inverter	Yes /No		
	Compatibility with proposed monitoring system	Yes /No		
	Over load capacity (for 10 sec) should be 200% of continuous rating.	Yes /No		
	Whether the Inverter comply with IEEE 1547?	Yes /No		
	Whether the Inverter is Capable of withstanding an Unbalanced Output Load to the Extent of 30 %?	Yes /No		
	Whether Self Protective and Self-Diagnostic Features in accordance with Clause 2.4 (d)?	Yes /No		
	Whether the Inverter Automatically Go to Shutdown/Standby Modes and Restart as Described in Clause 2.4 (e)?	Yes /No		
	Compliance in Accordance with Clause 5.4 (h)?	Yes /No		
	Whether the Inverter withstand High Voltage Test in accordance with Clause 2.4 (I)?	Yes /No		
	Whether the Full Protection against Accidental Open Circuit and Reverse Polarity at the Input Provided?	Yes /No		
	Compliance in Accordance with Clause 2.4 (k)?	Yes /No		
	Whether Galvanic Isolation is Provide when Inverter is selected with a Transformer in accordance with Clause 2.4 (n)-(ii) Provided?	Yes /No		
	Warranty Period of the Inverter?	Years		
	manufacturing experience in years	Years		
	Is a copy of ISO 9001:2008 certificate is attached.	Yes /No		
	is the quality plan attached	Yes /No		
	is a copy of the international certification to the European union is attached	Yes /No		
	Whether the Copies of Routine and Type Test Reports Provided?	Yes /No		

2.5 Schedule of Guaranteed Technical Particulars for Cluster Switch Box and Accessories

Ref.	Description	Offered	Comments
	Cluster Switch Box		
	Whether the Cluster Switch Box completely wired and fitted in the factory?		
	Current Rating of the Bus-bar		
	Whether the cluster Switch Box is Compatible with inverters and diesel generators used in the system?		
	Outgoing Connection		
	Whether the Cluster Switch Box is Equipped with wiring connections, isolators, breakers, fuses, relays and earthling equipment?		
	Whether the Cluster Switch Box has HRC fuses for All the Inverters?		
	Whether Separate MCBs are Provided for each Cluster Inverters?		
	Operating Temperature Range		
	IP Rating of the Cluster Switch Box		
	Whether the Cluster Switch Box is Painted in accordance with the Description Available in the CEB Specification?		
	Whether Provisions are Provided to Connect the Diesel Generator?		
	Whether a Set of Contactors shall be Available for Load Shedding Purposes?		
	Whether all the Communication Cables Provided by the Supplier?		
	Whether the Cluster Switch Box Incorporate Active Anti-islanding and Reverse Current Monitoring Facilities?		
	Whether an Automatic Bypass for the PV Generators is Available?		
	Minimum Lifetime of the Cluster Switch Box?		
	Warranty Period		
	Whether Following are Provided with the Offer?		
	A Catalogue Describing Make, Model and Features		
	Complete Technical Literature Including Operational and Maintenance Manual		
	Type and Routine Test Reports		
	Warranty Certificate		
	ISO 9001:2008 Certificate for the plant where Cluster Switch Box is Manufactures		
	Quality Plan		
	Over Voltage Category in Accordance with IEC 60664		
	The Short Time Withstand Voltage		
	Rated AC Insulation Voltage of Wiring		

2.6 Schedule of Guaranteed Technical Particulars for Remote Monitoring and Controlling System

Ref	Description		Offered	Comments
	Whether the System has Following Main Features?			
	system monitoring			
	Remote Diagnosis			
	Data Storage and Visualization of System Information			
	The Monitoring System shall Capture, Store and Transmit Real Time Parameters of the Solar Power Plants, Wind Power Plants, Diesel Genet, Battery System and Ambient Conditions for Report Generation			
	Online Analysis of Plant Performance			
	Generate Remote Site Alarms and Error Reporting Through email/sms			
	Retrieve Collected Information at Any Location by Web Portal Software and Mobile Phone Application Software			
	Whether the System Data Collection is Real Time?			
	Method of Data Transmission from Sensors to Central Data Collector			
	Method of Data Transmission from Central Data Collector to Web Portal			
	Data Logging Time Duration of the Equipment			
	Central Server Data Storage Duration (Minimum)			
	Whether a Desktop Computer in Accordance with the CEB / SLSEA Requirements is Provided?			
	Whether a 3G/4G Modem and A Wireless Router are Provided in n Accordance with CEC Specification			
	Whether a Real Time Controller Software is Provide			
	Whether the Supplier is Maintaining Maintain a Web Service Module and a Web Server Module			
	Whether Following are Included in Control/Monitoring System Information?			
	Real Time Chart Information			
	Historical Information			
	Alarm and Event Logging			
	Report Generator			
	Whether the Application has Following Two Security Levels			
	Monitoring Purposes			
	Operational and Maintenance			
	Whether Following Parameters are Recorded and Available for Monitoring?			
	PV Units			
	PV Array Energy Production			
	DC Voltage Output			
	DC Current			
	Operation Status (On/off/curtailment/MPPT etc.)			
	Operation Time			
	Solar Panel Temperature			
	Insulation Resistance of the PV Array			

	Wind Units			
	AC Voltage			
	AC Current			
	Energy Generated			
	Operation Status (On/off/curtailment/MPPT etc.)			
	Operation Time			
	Diesel Gen Set			
	AC Voltage			
	AC Current on Each Phase			
	Energy Generated (active and reactive)			
	Frequency			
	Operation Status (run/warming/cooling/fail etc.)			
	Operation Time Period			
	Diesel Consumption			
	Battery Energy System			
	DC Voltage			
	DC Current			
	AC Voltage of Each Phase Energy Generated (active and reactive)			
	Frequency			
	Operation Status (charging/discharging/fail etc.)			
	State of Charge (SOC)			
	Battery Health Indices (temperature/emission level etc.)			
	Hybrid Energy System			
	AC Voltage			
	AC Current on Each Phase			
	Total Demand (active and reactive)			
	Frequency			
	Power Factor			
	Operation Status (on/off etc.)			
	An Event Recorder Information (Recording Low/Over Frequency, Low/Over Voltage, Earth Fault and Overcurrent Events)			
	Weather Condition of the Site			
	Solar Irradiance			
	Temperature			
	Average Wind Speed			
	Humidity			
	Warranty Period			
	Whether a Comprehended Description of Monitoring/Controlling System is Provided Including Following			
	Schematic Drawing of the Proposed System			
	Sensor Details			
	Connecting Protocols			
	Communication Equipment with Maximum Possible Distances			
	Program Operating Guide			
	Operating and Maintenance Manuals			
	Recommended Wire Types			
	Whether an On-Site Training for Engineers/Technicians of CEB/SLSEA in accordance with Clause 6.4			

3. Times for Delivery & completion and contract completion time

The Schedule shall be completed by the contractor and the times entered shall be binding on the contractor.

The latest date by which an order must be placed to permit completion by the specified dates shall be entered, together with the guaranteed periods in weeks from placing of order to the completion of the lines.

All periods shall be in weeks, calculated from the latest date for placing the order. (In addition to the following table, Gantt chart should also be attached)

Construction of Material for Wind, Solar and Diesel Hybrid System

Period in Weeks after awarding	Commence	Complete
Delivery of materials. Storing in a safe place. • Foundations for wind turbines and pergola. • Extension of the existing 1 phase power line to a 3-phase power line with Neutral. The estimated length is around 500 m. Rec. cable section: CU 4 x 95 mm • Preparing ditches for cabling between wind turbines and new powerhouse to The grid connection point which will be closed to the church. • Construction of the pergola structure with standard materials. • Construction of the new powerhouse with bricks as a part of the pergola. • Design and construction for PV-panels structure with standard material. • Installation of the PV-panels on the hospital- and MPB – roof. • Identifying a suitable place (unreachable for children and not exposed to the Sun) for the two different grid-inverters and mounting it. • Identifying the next 3-fase connection points and looking for a convincing course for the cables. Maybe it's necessary for making ditches • Installation of the PV-panels on the pergola roof. • Erection of the wind turbines. • Installation of the batteries, inverters, grid inverters, Central Switchbox (CSB)		

4. Deviations from the Specification

(To be completed by the contractor)

Clause No.	Departures from the requirements of this specification with details of alternative

5. Manufacturer's and subcontractor's statement of experience

5.1 Site Organization

5.1.1 Field Staff Details

5.1.2 Key Personnel's Details

Designation	Name of (i) Nominee (ii) Alternate	Summary of Qualification Experience & Present Occupation	Year of Birth
Headquarters			
Project Director			
Project Manager			
Engineering Design Staff			
Other key Staff (Give Designation)			
Site Office			
Project Manager			
Site Manager			
Deputy Site Manager			
Supervising Engineers			
Construction Supervisors			
Other Key Staff			

The Bidder shall list in this schedule the key personnel (including first nominee and the second choice alternate) he will employ from headquarters and from site office to direct and execute the works.

5.2 Bidder's Experience (New Construction)

5.3 Volume of Construction Work In Each of the Last Five Years

Year	Description of the Work	Volume of construction work in US $

5.4 Details of Other Work in Hand & Contractual Commitments

Description of other work in hand	Contractual commitments

5.5 Schedule of Sub Contractors

Item	Element of work	Approximate Value in percentage	Name and address of Sub Contractor	Statement of Similar Works executed

The Bidder shall enter in this schedule a list of the sections and appropriate value of the work for which the purposes to use sub contractors, together with the names and addresses of the proposed sub contractors. The bidder shall also enter a statement of similar works previously executed by the proposed sub contractors, including description, location and value of works, year completed, and name and addresses of the Employer Notwithstanding such information the bidder, if awarded the contract, shall remain entirely and solely responsible for the satisfactory completion of the Works.

6. Documents, Drawings and Information to be submitted with the bid

7. Adherence to the Environmental Acts, Regulations and/or Guidelines

Environmental Safeguard Documents prepared under National Environmental Act (NEA)-

Part E - Bank Guarantees & Certificates and Change Orders

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5. Bank Guarantees and Certificates

5.1 Form of Completion Certificate

Contract: [. . . . *.insert name of contract and contract identification details. .....*]

Date: .....

Certificate No.: .....

To: [. . . . *.insert name and address of contractor.*]

Dear Ladies and/or Gentlemen,

Pursuant to GCC Clause 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . . . *.insert date.* . . . .], relating to the [. . . *.brief description of the Facilities*], 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 Employer 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: [. . . *.description.....*]

2. Date of Completion: [. . . *.date.....*]

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,

[. . . *.Signature*]

Project Manager

5.2 Form of Operational Acceptance Certificate

Contract: [. . . . .*insert name of contract and contract identification details*.....]

Date: .....

Certificate No.: .....

To: [. . . . .*insert name and address of contractor*.....]

Pursuant to GCC Subclause 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . .*date*. . .], relating to the [.....*brief description of the facilities*.....], 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: [. . . *description*.....]

2. Date of Operational Acceptance: [. . . *date*.....]

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,

[. . . .*Signature* .....]

Project Manager

6. Change Orders

6.1 Change Order Procedure

6.1.1 General
6.1.2 Change Order Log
6.1.3 References for Changes

6.2. Change Order Forms

6.2.1 Request for Change Proposal
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6.2.7 Application for Change Proposal

6.1. Change Order Procedure

6.1.1 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 39 (Change in the Facilities) of the General Conditions.

6.1.2 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. 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 Employer.

6.1.3 References for Changes

(1) Request for Change as referred to in GCC Clause 39 shall be serially numbered CR-X-nnn.

(2) Estimate for Change Proposal as referred to in GCC Clause 39 shall be serially numbered CN-X-nnn.

(3) Acceptance of Estimate as referred to in GCC Clause 39 shall be serially numbered CA-X-nnn.

(4) Change Proposal as referred to in GCC Clause 39 shall be serially numbered CP-X-nnn.

(5) Change Order as referred to in GCC Clause 39 shall be serially numbered CO-X-nnn.

Note:

(a) Requests for Change issued from the Employer's Home Office and the Site representatives of the Employer 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.

6.2 Change Order Forms

6.2.1 Request for Change Proposal Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

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 [*number*] days of the date of this letter [or on or before (*date*)].

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Originator of Change:
   Employer: [Name]
   Contractor (by Application for Change Proposal No. [Number Refer to Annex 6.2.7])
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Description*]
6. Reference drawings and/or technical documents for the request of Change:
   Drawing No./Document No. *Description*
7. Detailed conditions or special requirements on the requested Change: [*Description*]
8. General Terms and Conditions:
   (a) Please submit your estimate 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 completing the requested Change.
   (c) If you have any opinion that is critical 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 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.

[*Employer's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

6.2.2 Estimate for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost to prepare the below-referenced Change Proposal in accordance with GCC Subclause 39.2.1 of the General Conditions. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with GCC Subclause 39.2.2, is required before estimating the cost for change work.

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Brief Description of Change: [*Description*]
4. Scheduled Impact of Change: [*Description*]
5. Cost for Preparation of Change Proposal: [*insert costs, which shall be in the currencies of the contract*]

(a)	Engineering		(Amount)
	(i)	Engineer _____ hours (hrs) x rate/hr =	_____
	(ii)	Draftsperson _____ hrs x _____ rate/hr =	_____
		Sub-total _____ hrs	_____
		Total Engineering Cost	_____
(b)	Other Cost		_____
	Total Cost (a) + (b)		_____

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

6.2.3 Acceptance of Estimate Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

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: [*Title*]
2. Change Request No./Rev.: [*Request number/revision*]
3. Estimate for Change Proposal No./Rev.: [*Proposal number/revision*]
4. Acceptance of Estimate No./Rev.: [*Estimate number/revision*]
5. Brief Description of Change: [*Description*]
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 preparing the Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with GCC Clause 39 of the General Conditions.

[*Employer's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

6.2.4 Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

In response to your Request for Change Proposal No. [Number], we hereby submit our proposal as follows:

1. Title of Change: [*Name*]
2. Change Proposal No./Rev.: [*Proposal number / revision*]
3. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]
4. Brief Description of Change: [*Description*]
5. Reasons for Change: [*Reason*]
6. Facilities and/or Item No. of Equipment related to the requested Change: [*Facilities*]
7. Reference drawings and/or technical documents for the requested Change:
   [*Drawing/Document No./Description*]
8. Estimate of increase/decrease to the Contract Price resulting from the Change Proposal:

		Amount [*insert amounts in the currencies of the Contract*]
(a)	Direct material	_____
(b)	Major construction equipment	_____
(c)	Direct field labor (Total hrs)	_____
(d)	Subcontracts	_____
(e)	Indirect material and labor	_____
(f)	Site supervision	_____
(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 Employer
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 [Number] 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: [*..... insert amount. This cost shall be reimbursed by the employer in case of employer's withdrawal or rejection of this Change Proposal without default of the contractor in accordance with GCC Clause 39 of the General Conditions.....*]

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

6.2.5 Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal (No. [*number*]), and agree to adjust the Contract Price, Time for Completion, and/or other conditions of the Contract in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]
2. Change Request No./Rev.: [*Request number / revision*]
3. Change Order No./Rev.: [*Order number / revision*]
4. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]
5. Authorized Price:
   Ref. No.: [*Number*] Date: [*Date*]
   Foreign currency portion [*Amount*] plus Local currency portion [*Amount*]
6. Adjustment of Time for Completion
   None Increase [*Number*] days Decrease [*Number*] days
7. Other effects, if any

Authorized by: _____ Date: _____
Employer

Accepted by: _____ Date: _____
Contractor

6.2.6 Pending Agreement Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]
2. Employer's Request for Change Proposal No./Rev.: [*number/revision*] dated: [*date*]
3. Contractor's Change Proposal No./Rev.: [*number / revision*] dated: [*date*]
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Facilities*]
6. Reference Drawings and/or technical documents for the requested Change:
   [*Drawing / Document No. / Description*]
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

[*Employer's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

6.2.7 Application for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

We hereby propose that the work mentioned below be treated as a Change in the Facilities.

1. Title of Change: [*Name*]
2. Application for Change Proposal No./Rev.: [*Number / revision*] dated: [*Date*]
3. Brief Description of Change: [*Description*]
4. Reasons for Change:
5. Order of Magnitude Estimation (amount in the currencies of the Contract): [*Amount*]
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

7. Personnel Requirements

Using Form PER-1 and PER-2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

No.	Position	Minimum Requirement	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager	1	10	5
2	Design Engineer-Electrical	1	10	5
3	Design Engineer-Civil	1	10	5
4	Site Engineers	3	5	5
5	Supervisors	4	5	5

8. Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment to be used by the contractor for this project in the format given below: Please specially consider the requirements for rough/shallow sea transportation, road transportation and installations in isolated islands.

No.	Equipment Type and Characteristics	Minimum Number Required
1		
2		
3		
4		
5		

PART 3 –
Conditions of Contract and Contract Forms

Section 7 - General Conditions of Contract

These General Conditions of Contract (GCC) are based on the Model Form of International Contract for Process Plant Construction published by the Engineering Advancement Association of Japan (ENAA). The Multilateral Development Banks (MDBs) participating in the procurement harmonization process gratefully acknowledge the contribution of ENAA to the advancement of good contracting practices by its borrowers. The GCC contain general clauses to be applied on all contracts. The GCC in this section, read in conjunction with the Special Conditions of Contract in Section 8 and other documents listed therein, should be a complete document expressing all the rights and obligations of the contracting parties. The General Conditions herein shall not be altered.

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General Conditions of Contract

A. Contract and Interpretation

1. Definitions

1.1 The following words and expressions shall have the meanings hereby assigned them:

"Contract" means the Contract Agreement entered into between the Employer and the Contractor, together with the Contract Documents referred to therein; they shall constitute the Contract, and the term "the Contract" shall in all such documents be construed accordingly.

"Contract Documents" means the documents listed in Article 1.1 (Contract Documents) of the Contract Agreement (including any amendments thereto).

"GCC" means the General Conditions of Contract.

"SCC" means the Special Conditions of Contract.

"day" means calendar day.

"year" means 365 days.

"month" means calendar month.

"Party" means the Employer or the Contractor, as the context requires.

"Employer" means the person named as such in the SCC and includes the legal successors or permitted assigns of the Employer.

"Project Manager" means the person appointed by the Employer in the manner provided in GCC Subclause 17.1 (Project Manager) hereof and named as such in the SCC to perform the duties delegated by the Employer.

"Contractor" means the person(s) named as Contractor in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

"Contractor's Representative" means any person nominated by the Contractor and approved by the Employer in the manner provided in GCC Subclause 17.2 (Contractor's Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.

"Construction Manager" means the person appointed by the Contractor's Representative in the manner provided in GCC Subclause 17.2.4.

"Subcontractor," including manufacturers, means any person to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant, is sub-contracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.

"Dispute Board" means the person or persons named as such in the SCC appointed by agreement between the Employer and the Contractor to make a decision on or to settle any dispute or difference between the Employer and the Contractor referred to him or her by the parties pursuant to GCC Subclause 45.1 (Dispute Board) hereof.

"The Bank" means the financing institution named in the SCC.

"Contract Price" means the sum specified in Article 2.1 (Contract Price) of the Contract Agreement, subject to such additions and adjustments thereto or deductions therefrom, as may be made pursuant to the Contract.

"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.

"Plant" means permanent plant, equipment, machinery, apparatus, articles 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 under GCC Subclause 7.3 hereof), but does not include Contractor's Equipment.

"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, precommissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc. as the case may require.

"Contractor's 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.

"Country of Origin" means the countries and territories eligible under the rules of the Bank as further elaborated in the SCC.

"Site" means the land and other places upon which the Facilities are to be installed, and such other land or places as may be specified in the Contract as forming part of the Site.

"Effective Date" means the date of fulfillment of all conditions stated in Article 3 (Effective Date) of the Contract Agreement, upon which the period until the Time for Completion shall be counted from.

"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, as referred to in GCC Clause 8 and in accordance with the relevant provisions of the Contract.

"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 Precommissioning of the Facilities or such specific part thereof has been completed, and that the Facilities or specific part thereof are ready for Commissioning as provided in GCC Clause 24 (Completion) hereof.

"Precommissioning" means the testing, checking and other requirements specified in the Employer's Requirements that are to be carried out by the Contractor in preparation for Commissioning as provided in GCC Clause 24 (Completion) hereof.

"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 as provided in GCC Subclause 25.1 (Commissioning) hereof, for the purpose of carrying out Guarantee Test(s).

"Guarantee Test(s)" means the test(s) specified in the Employer'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 (Functional Guarantees) to the Contract Agreement in accordance with the provisions of GCC Subclause 25.2 (Guarantee Test) hereof.

"Operational Acceptance" means the acceptance by the Employer 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 GCC Clause 28 (Functional Guarantees) hereof and shall include deemed acceptance in accordance with GCC Clause 25 (Commissioning and Operational Acceptance) hereof.

"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 GCC Clause 27 (Defect Liability) hereof.

2. Contract Documents

2.1 Subject to Article 1.2 (Order of Precedence) of the Contract Agreement, all documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole.

3. Interpretation

3.1 In the Contract, except where the context requires otherwise,

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree," "agreed," or "agreement" require the agreement to be record in writing;

(d) the word “tender” is synonymous with “bid,” “tenderer” with “Bidder,” and “tender documents” with “Bidding Documents;” and

(e) “written” or “in writing” means handwritten, typewritten, printed or electronically made, and resulting in a permanent record.

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

3.2 Incoterms

Unless inconsistent with any provision of the Contract, the meaning of any trade term and the rights and obligations of parties thereunder shall be as prescribed by Incoterms.

“Incoterms” means international rules for interpreting trade terms published by the International Chamber of Commerce (latest edition), 38 Cours Albert 1er, 75008 Paris, France.

3.3 Entire Agreement

Subject to GCC Subclause 16.4 hereof, the Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations, and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract.

3.4 Amendment

No amendment or other variation of the Contract shall be effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party hereto.

3.5 Independent Contractor

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture, or other joint relationship between the parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives, or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives, or Subcontractors and the Employer.

3.6 Non-Waiver

3.6.1 Subject to GCC Subclause 3.6.2 below, 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, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

3.6.2 Any waiver of a party’s rights, powers, or remedies under the

Contract must be in writing, must be 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.

3.7 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.

3.8 Country of Origin
"Origin" means the place where the plant and 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 in its basic characteristics or in purpose or utility from its components.

4. Communications

4.1 Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests, and discharges, these communications shall be

(a) in writing and delivered against receipt; and

(b) delivered, sent, or transmitted to the address for the recipient's communications as stated in the Contract Agreement.

When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Project Manager, a copy shall be sent to the Project Manager or the other Party, as the case may be.

5. Law and Language

5.1 The Contract shall be governed by and interpreted in accordance with laws of the country specified in the SCC.

5.2 The ruling language of the Contract shall be that stated in the SCC.

5.3 The language for communications shall be the ruling language unless otherwise stated in the SCC.

6. Ethics, Fraud and Corruption

6.1 The attention of the bidders is drawn to the following guidelines of the Procurement Guidelines published by National Procurement Agency:

(a) Parties associated with the procurement actions, namely, suppliers/contractors and officials shall ensure that they maintain strict confidentiality throughout the process;

(b) Officials shall refrain from receiving any personal gain from any Procurement Action. No gifts or inducement shall be accepted. Suppliers/contractors are liable to be disqualified from the bidding process if found offering any gift or inducement which may have an effect of influencing decision or impairing the objectivity of an official. Anticorruption Policy requires employer (including beneficiaries of financed activity) as well as Bidders, Suppliers, and Contractors under-financed contract, observe the highest standard of ethics during the procurement and execution of such contract.

(c) “corrupt practice” means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(d) “fraudulent practice” means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain

a financial or other benefit or to avoid an obligation;

(e) “coercive practice” means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(f) “collusive practice” means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

B. Subject Matter of Contract

7. Scope of Facilities

7.1 Unless otherwise expressly limited in the Employer's Requirements, the Contractor's obligations cover the provision of all Plant and the performance of all Installation Services required for the design, 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 Employer'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 (as specified in GCC Subclause 7.3 below) 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 Employer, as set forth in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement.

7.2 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.

7.3 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 SCC and the provisions, if any, specified in the SCC. 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 Employer and the Contractor, and the price of such spare parts shall be that given in Price Schedule No. 6, which shall be added

[1] Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other capacity (different names are used depending on the particular Bidding Document).

to the Contract Price. The price of such spare parts shall include the purchase price therefore and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts.

8. Time for Commencement and Completion

8.1 The Contractor shall commence work on the Facilities within the period specified in the SCC and without prejudice to GCC Subclause 26.2 hereof, the Contractor shall thereafter proceed with the Facilities in accordance with the time schedule specified in the Appendix 4 (Time Schedule) to the Contract Agreement.

8.2 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 SCC or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

9. Contractor's Responsibilities

9.1 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.

9.2 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 Employer, 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 28 days prior to bid 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.

9.3 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 Employer under GCC Subclause 10.3 hereof and that are necessary for the performance of the Contract.

9.4 The Contractor shall comply with all laws in force in the country where the Facilities are to be implemented. The laws will include all local, state, national, or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties, and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to GCC Subclause 10.1 hereof.

9.5 Any plant and services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under GCC Clause 1 (Country of Origin). Any Subcontractors retained

by the Contractor shall be from a country as specified in GCC Clause 1 (Country of Origin).

9.6 The Contractor shall permit GOSL to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by GOSL.

9.7 If the Contractor is a joint venture or consortium of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfillment of the provisions of the Contract and shall designate one of such persons to act as a leader with authority to bind the joint venture or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer.

9.8 Protection of the Environment

(a) The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise, and other results of his operations.

(b) The Contractor shall ensure that emissions, surface discharges, and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

10. Employer's Responsibilities

10.1 All information and/or data to be supplied by the Employer as described in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement shall be deemed to be accurate, except when the Employer expressly states otherwise.

10.2 The Employer 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 (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of and accord all rights of access thereto on or before the date(s) specified in that Appendix.

10.3 The Employer 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 Employer to obtain in the Employer's name, (b) are necessary for the execution of the Contract, including those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract, and (c) are specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement.

10.4 If requested by the Contractor, the Employer shall use its best endeavors 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.

10.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer 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 (Scope of Works and Supply by the Employer) to the Contract Agreement at or before the time specified in the program furnished by the Contractor under GCC Subclause 18.2 hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.

10.6 The Employer shall be responsible for the continued operation of the Facilities after Completion, in accordance with GCC Subclause 24.8, and shall be responsible for facilitating the Guarantee Test(s) for the Facilities, in accordance with GCC Subclause 25.2.

10.7 All costs and expenses involved in the performance of the obligations under this GCC Clause 10 shall be the responsibility of the Employer, except those incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with GCC Subclause 25.2.

10.8 In the event that the Employer shall be in breach of any of his obligations imposed by the Contract, then the additional cost reasonably incurred by the Contractor in consequence thereof shall be added to the Contract Price.

C. Payment

11. Contract Price

11.1 The Contract Price (in USD) shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement.

11.2 Unless an adjustment clause is provided for in the SCC, 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.

11.3 Subject to GCC Subclauses 9.2, 10.1, and 35 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.

12. Terms of Payment

12.1 The Contract Price shall be paid as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement and in the Appendix (Terms and Procedures of Payment) to the Contract

Agreement, which also outlines the procedures to be followed in making application for and processing payments.

12.2 No payment made by the Employer herein shall be deemed to constitute acceptance by the Employer of the Facilities or any part(s) thereof.

12.3 In the event that the Employer fails to make any payment by its respective due date or within the period set forth in the Contract, the Employer shall pay to the Contractor interest on the amount of such delayed payment at the rate(s) shown in the Appendix (Terms and Procedures of Payment) to the Contract Agreement for the period of delay until payment has been made in full, whether before or after judgment or arbitrage award.

12.4 The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, 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 bid.

13. Securities

13.1 Issuance of Securities

The Contractor shall provide the securities specified below in favor of the Employer at the times, and in the amount, manner, and form specified below.

13.2 Advance Payment Security

13.2.1 The Contractor shall, within 28 days of the notification of contract award, provide a security in an amount equal to the advance payment in USD calculated in accordance with the Appendix (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency or currencies.

13.2.2 The security shall be in the form provided in the Bidding Documents or in another form acceptable to the Employer. 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 Employer. The security shall be returned to the Contractor immediately after its expiration.

13.3 Performance Security

13.3.1 The Contractor shall, within 28 days of the notification of contract award, provide a security for the due performance of the Contract in the amount (in USD) specified in the SCC.

13.3.2 The security shall be denominated in the currency or currencies of the Contract, or in a freely convertible currency acceptable to the Employer, and shall be in one of the forms of bank guarantees provided in the Bidding Documents, as stipulated by the Employer in the SCC, or in another form acceptable to the Employer.

13.3.3 Unless otherwise specified in the SCC, 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, 540 days after Completion of the Facilities or 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 Subclause 27.8 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 Subclause 27.10, is liable for an extended defect liability obligation, the performance security shall be extended for the period and up to the amount specified in the SCC.

14. Taxes and Duties

14.1 Except as otherwise specifically provided in the Contract, the Contractor shall bear and pay all taxes, duties, levies, and 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.

14.2 Notwithstanding GCC Subclause 14.1 above, the Employer shall bear and promptly pay all customs and import duties as well as other local taxes like, e.g., a value-added tax (VAT), imposed by the law of the country where the Site is located on the Plant specified in Price Schedule No. 1 and that are to be incorporated into the Facilities.

14.3 If any tax exemptions, reductions, allowances, or privileges may be available to the Contractor in the country where the Site is located, the Employer shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.

14.4 For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies, and charges prevailing at the date 28 days prior to the date of bid submission in the country where the Site is located (hereinafter called "Tax" in this GCC Subclause 14.4). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor, Subcontractors, or their employees in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with GCC Clause 36 hereof.

D. Intellectual Property

15. License/Use of Technical Information

15.1 For the operation and maintenance of the Plant, the Contractor hereby grants a non-exclusive and nontransferable license (without the right to sublicense) to the Employer 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 Employer a nonexclusive and nontransferable right (without the right to sublicense) to use the know-how and other technical information disclosed to the Employer 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 Employer.

15.2 The copyright in all drawings, documents, and other materials containing data and information furnished to the Employer by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Employer 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.

16. Confidential Information

16.1 The Employer 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 termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data, and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this GCC Clause 16.

16.2 The Employer shall not use such documents, data, and other information received from the Contractor for any purpose other than the operation and maintenance of the Facilities. Similarly, the Contractor shall not use such documents, data, and other information received from the Employer for any purpose other than the design, procurement of Plant, construction, or such other work and services as are required for the performance of the Contract.

16.3 The obligation of a party under GCC Subclauses 16.1 and 16.2 above, however, shall not apply to that information, which

(a) now or hereafter enters the public domain through no fault of that party;

(b) 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 hereto; and

(c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality.

16.4 The above provisions of this GCC Clause 16 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 Facilities or any part thereof.

16.5 The provisions of this GCC Clause 16 shall survive termination, for whatever reason, of the Contract.

E. Execution of the Facilities

17. Representatives

17.1 Project Manager

If the Project Manager is not named in the Contract, then within 14 days of the Effective Date, the Employer shall appoint and notify the Contractor in writing of the name of the Project Manager. The Employer may from time to time appoint some other person as the Project Manager in place of the person previously so appointed, and shall give 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 Employer 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.

All notices, instructions, information, and other communications given by the Contractor to the Employer under the Contract shall be given to the Project Manager, except as herein otherwise provided.

17.2 Contractor's Representative and Construction Manager

17.2.1 If the Contractor's Representative is not named in the Contract, then within 14 days of the Effective Date, the Contractor shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person so appointed. If the Employer makes no objection to the appointment within 14 days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within 14 days giving the reason therefor, then the Contractor shall appoint a replacement within 14 days of such objection, and the foregoing provisions of this GCC Subclause 17.2.1 shall apply thereto.

17.2.2 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.

All notices, instructions, information, and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided.

The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the

procedure set out in GCC Subclause 17.2.1.

17.2.3 The Contractor's Representative may, subject to the approval of the Employer 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 Employer 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 Subclause 17.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.

17.2.4 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, the Contractor's Representative or the Construction Manager shall appoint a suitable person to act as the Construction Manager's deputy.

17.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under GCC Subclause 22.4. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.

17.2.6 If any representative or person employed by the Contractor is removed in accordance with GCC Subclause 17.2.5, the Contractor shall, where required, promptly appoint a replacement.

18. Work Program

18.1 Contractor's Organization

The Contractor shall supply to the Employer and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities within 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 Employer and the Project Manager in writing of any revision or alteration of such an organization chart.

18.2 Program of Performance

Within 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 Employer 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 (Time Schedule) to the Contract Agreement 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 given in the SCC and any extension granted in accordance with GCC Clause 40, and shall submit all such revisions to the Project Manager.

18.3 Progress Report

The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Subclause 18.2 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.

18.4 Progress of Performance

If at any time the Contractor's actual progress falls behind the program referred to in GCC Subclause 18.2, or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Employer 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 Subclause 8.2, any extension thereof entitled under GCC Subclause 40.1, or any extended period as may otherwise be agreed upon between the Employer and the Contractor.

18.5 Procedures

The Contract shall be executed in accordance with the Contract Documents including the procedures given in the Forms and Procedures of the Employer'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.

19. Subcontracting

19.1 The Appendix 5 (List of Major Items of Plant and Services and List of Approved Subcontractors) to the Contract Agreement specifies major items of plant and services and a list of approved Subcontractors against each item, including manufacturers. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to the Employer for its approval in sufficient

time so as not to impede the progress of work on the Facilities. Such approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties, or responsibilities under the Contract.

19.2 The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in GCC Subclause 19.1.

19.3 For items or parts of the Facilities not specified in the Appendix (List of Major Items of Plant and Services and List of Approved Subcontractors for Major Items) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.

19.4 Each subcontract shall include provisions which would entitle the Employer to require the sub-contract to be assigned to the Employer under GCC 19.5 (if and when applicable), or in event of termination by the Employer under GCC 42.2.

19.5 If a Sub-contractor's obligations extend beyond the expiry date of the relevant Defects Liability Period and the Project Manager, prior to that date, instructs the Contractor to assign the benefits of such obligations to the Employer, then the Contractor shall do so.

20. Design and Engineering

20.1 Specifications and Drawings

20.1.1 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 Employer.

20.1.2 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 Employer, by giving a notice of such disclaimer to the Project Manager.

20.2 Codes and Standards

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 28 days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied subject to approval by the Employer and shall be treated in accordance with GCC Clause 39.

20.3 Approval/Review of Technical Documents by Project Manager

20.3.1 The Contractor shall prepare or cause its Subcontractors to prepare, and furnish to the Project Manager the documents listed in the Appendix (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as

specified and in accordance with the requirements of GCC Subclause 18.2 (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 Subclauses 20.3.2 through 20.3.7 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only.

20.3.2 Within 14 days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Subclause 20.3.1, 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 14 days, then the said document shall be deemed to have been approved by the Project Manager.

20.3.3 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. If the Project Manager disapproves a document, he shall specify the reasons for his decision.

20.3.4 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 Subclause 20.3.2. 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.

20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Dispute Board for determination in accordance with GCC Subclause 45.3 hereof. If such dispute or difference is referred to an Dispute Board, the Project Manager shall give instructions as to whether and, if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Dispute Board upholds the Contractor's view on the dispute and if the Employer has not given notice under Subclause 45.3 hereof, then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Dispute Board shall decide, and the Time for Completion shall

be extended accordingly.

20.3.6 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.

20.3.7 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 Subclause 20.3.

If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 39 shall apply to such request.

21. Procurement

21.1 Materials

Subject to GCC Subclause 14.2, the Contractor shall procure and transport all materials in an expeditious and orderly manner to the Site.

21.2 Employer-Supplied Materials

If the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement provides that the Employer shall furnish any specific items to the Contractor, the following provisions shall apply:

21.2.1 The Employer 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 Subclause 18.2, unless otherwise mutually agreed.

21.2.2 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 Employer shall immediately remedy any shortage, defect, or default, or the Contractor shall, if practicable and possible, at the request of the Employer, remedy such shortage, defect, or default at the Employer's cost and expense. After inspection, such item shall fall under the care, custody, and control of the Contractor. The provision of this GCC Subclause 21.2.2 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.

21.2.3 The foregoing responsibilities of the Contractor and its obligations of care, custody, and control shall not relieve the Employer 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 27 or under any other provision of Contract.

21.3 Transportation

21.3.1 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.

21.3.2 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.

21.3.3 Upon dispatch of each shipment of materials and the Contractor's Equipment, the Contractor shall notify the Employer 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 Employer with relevant shipping documents to be agreed upon between the parties.

21.3.4 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 Employer 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 Employer 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.

21.4 Customs Clearance

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 Employer's obligations under GCC Subclause 14.2, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Employer, the Employer 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 40.

22. Installation

22.1 Setting Out/Supervision

22.1.1 Benchmark

(a) 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 Employer.

(b) 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 Employer, the expense of rectifying the same shall be

borne by the Employer.

22.1.2 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.

22.2 Labor

22.2.1 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 Employer 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 Employer may provide the same to such personnel and recover the cost of doing so from the Contractor.

22.2.2 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labor from amongst the Employer's Personnel.

22.2.3 Labor Laws

(a) The Contractor shall comply with all the relevant labor

Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights.

(b) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous, or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.

(c) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious, or other customs and all local laws and regulations pertaining to the employment of labor.

22.2.4 Rates of Wages and Conditions of Labor

(a) The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

(b) The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

22.2.5 Working Hours

(a) No work shall be carried out on the Site on locally recognized days of rest, or outside the normal working hours stated in the SCC, unless

(i) otherwise stated in the Contract;

(ii) the Project Manager gives consent; or

(iii the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Project Manager.

(b) If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Project Manager's consent thereto, the Project Manager shall not unreasonably withhold such consent.

(c) This Subclause shall not apply to any work which is customarily carried out by rotary or double shifts.

22.2.6 Facilities for Staff and Labor

(a) 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 Employer's Personnel as stated in the Specification.

(b) 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.

22.2.7 Health and Safety

(a) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay, and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

(b) 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 protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

(c) The Contractor shall send to the Project Manager, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety, and welfare of persons, and damage to property, as the Project Manager may reasonably require.

22.2.8 Funeral Arrangements
In the event of the death of any of the Contractor's personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate arrangements for their return or burial, unless otherwise specified in the SCC.

22.2.9 Records of Contractor's Personnel
The Contractor shall keep accurate records of the Contractor's personnel, including the number of each class of Contractor's Personnel on the Site and the names, ages, gender, hours worked, and wages paid to all workers. These records shall be summarized on a monthly basis in a form approved by the Project Manager and shall be available for inspection by the Project Manager until the Contractor has completed all work.

22.2.10 Supply of Foodstuff

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

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

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

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

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

22.2.15 Prohibition of All Forms of Forced or Compulsory Labor
The contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

22.2.16 Prohibition of Harmful Child Labor
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.

22.3 Contractor's Equipment

22.3.1 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.

22.3.2 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.

22.3.3 The Employer 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.

22.4 Site Regulations and Safety

The Employer 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 Employer, with a copy to the Project Manager, proposed Site regulations for the Employer'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.

22.5 Opportunities for Other Contractors

22.5.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Employer on or near the Site.

22.5.2 If the Contractor, upon written request from the Employer 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 Employer 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.

22.5.3 The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.

22.5.4 The Contractor shall notify the Project Manager promptly of any defects in the other Contractors' work that come to its notice, and that could affect the Contractor's work. The Project Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Project Manager shall be binding on the Contractor.

22.6 Emergency Work

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 Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer 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 Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.

22.7 Site Clearance

22.7.1 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.

22.7.2 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.

22.8 Watching and Lighting

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.

23. Test and Inspection

23.1 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.

23.2 The Employer and the Project Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the Employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and board and lodging expenses.

23.3 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 Employer and the Project Manager or their designated representatives to attend the test and/or inspection.

23.4 The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection.

If the Employer 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.

23.5 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 impedes 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.

23.6 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 Subclause 23.3.

23.7 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 Dispute Board for determination in accordance with GCC Subclause 45.3.

23.8 The Contractor shall afford the Employer and the Project Manager, at the Employer'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.

23.9 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 Employer or the Project Manager, nor the issue of any test certificate pursuant to GCC Subclause 23.4, shall release the Contractor from any other responsibilities under the Contract.

23.10 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.

23.11 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.

If any parts of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Subclause 23.10 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 Employer, 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.

24. Completion of the Facilities

24.1 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 Employer's Requirements, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing.

24.2 Within 7 days after receipt of the notice from the Contractor under GCC Subclause 24.1, the Employer shall supply the operating and maintenance personnel specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement for Pre- commissioning of the Facilities or any part thereof.

Pursuant to the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement, the Employer shall also provide, within the said 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.

24.3 As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Employer and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services, and other matters have been provided by the Employer in accordance with GCC Subclause 24.2, the Contractor shall commence Pre-commissioning of the Facilities or the relevant part thereof in preparation for Commissioning, subject to GCC Subclause 25.5.

24.4 As soon as all works in respect of Pre-commissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall so notify the Project Manager in writing.

24.5 The Project Manager shall, within 14 days after receipt of the Contractor's notice under GCC Subclause 24.4, either issue a Completion Certificate in the form specified in the Employer'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 under GCC Subclause 24.4, 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 described in GCC Subclause 24.4.

If the Project Manager is satisfied that the Facilities or that part thereof have reached Completion, the Project Manager shall, within 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.

If the Project Manager is not so satisfied, then it shall notify the Contractor in writing of any defects and/or deficiencies within 7 days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated.

24.6 If the Project Manager fails to issue the Completion Certificate and fails to inform the Contractor of any defects and/or deficiencies within 14 days after receipt of the Contractor's notice under GCC Subclause 24.4 or within 7 days after receipt of the Contractor's repeated notice under GCC Subclause 24.5, or if the Employer 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 Employer's use of the Facilities, as the case may be.

24.7 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 Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.

24.8 Upon Completion, the Employer 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.

25. Commissioning and Operational Acceptance

25.1 Commissioning

25.1.1 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 Subclause 24.5, or immediately after the date of the deemed Completion, under GCC Subclause 24.6.

25.1.2 The Employer shall supply the operating and maintenance personnel and all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services, and other matters required for Commissioning.

25.1.3 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 Employer.

25.2 Guarantee Test

25.2.1 Subject to GCC Subclause 25.5, 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 (Functional Guarantees) to the Contract Agreement. The Employer 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.

25.2.2 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 SCC or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and GCC Subclauses 28.2 and 28.3 shall not apply.

25.3 Operational Acceptance

25.3.1 Subject to GCC Subclause 25.4 below, Operational Acceptance shall occur in respect of the Facilities or any part thereof when

(a) the Guarantee Test has been successfully completed and the Functional Guarantees are met; or

(b) the Guarantee Test has not been successfully completed or has not been carried out for reasons not attributable to the Contractor within the period from the date of Completion specified in the SCC, or any other agreed upon period as specified in GCC Subclause 25.2.2 above; or

(c) the Contractor has paid the liquidated damages specified in GCC Subclause 28.3 hereof; and

(d) any minor items mentioned in GCC Subclause 24.7 hereof relevant to the Facilities or that part thereof have been completed.

25.3.2 At any time after any of the events set out in GCC Subclause 25.3.1 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Employer'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.

25.3.3 The Project Manager shall, after consultation with the Employer, and within 7 days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.

25.3.4 If within 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.

25.4 Partial Acceptance

25.4.1 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.

25.4.2 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.

25.5 Delayed Pre-Commissioning and/or Guarantee Test

25.5.1 In the event that the Contractor is unable to proceed with the Pre-commissioning of the Facilities pursuant to Subclause 24.3, or with the Guarantee Test pursuant to Subclause 25.2, for reasons attributable to the Employer either on account of non availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Employer's control, the provisions leading to "deemed" completion of activities such as Completion, pursuant to GCC Subclause 24.6, and Operational Acceptance, pursuant to GCC Subclause 25.3.4, and Contractor's obligations regarding Defect Liability Period, pursuant to GCC Subclause 27.2, Functional Guarantee, pursuant to GCC Clause 28, and Care of Facilities, pursuant to GCC Clause 32, and GCC Clause 41.1, Suspension, shall not apply. In this case, the following provisions shall apply.

25.5.2 When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to above Subclause 25.5.1, 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 Subclause 26.2;

(b) payments due to the Contractor in accordance with the provision specified in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, which would not have been payable in normal circumstances due to noncompletion 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 Employer, and which shall become null and void when the Contractor will have complied with its obligations regarding those payments, subject to the provision of Subclause 25.5.3 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 Employer;

(d) the additional charges towards the care of the Facilities pursuant to GCC Subclause 32.1 shall be reimbursed to

the Contractor by the Employer for the period between the notification mentioned above and the notification mentioned in Subclause 25.5.4 below. The provision of GCC Subclause 33.2 shall apply to the Facilities during the same period.

25.5.3 In the event that the period of suspension under above Subclause 25.5.1 actually exceeds 180 days, the Employer and Contractor shall mutually agree to any additional compensation payable to the Contractor.

25.5.4 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 all the specified activities and obligations under the contract.

F. Guarantees and Liabilities

26. Completion Time Guarantee

26.1 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 SCC pursuant to GCC Subclause 8.2, or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

26.2 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 40, the Contractor shall pay to the Employer liquidated damages in the amount specified in the SCC 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 SCC as a percentage rate of the Contract Price. Once the "Maximum" is reached, the Employer may consider termination of the Contract, pursuant to GCC Subclause 42.2.2.

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 40. The Contractor shall have no further liability whatsoever to the Employer 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 Subclause 26.2, the failure by the Contractor to attain any milestone or other act, matter or thing by any date specified in the Appendix (Time Schedule) to the Contract Agreement and/or other program of work prepared pursuant to GCC Subclause 18.2 shall not render the Contractor liable for any loss or damage thereby suffered by the Employer.

26.3 If the Contractor attains Completion of the Facilities or any part thereof before the Time for Completion or any extension thereof under GCC Clause 40, the Employer shall pay to the Contractor a bonus in the amount specified in the SCC. The aggregate amount of such bonus shall in no event exceed the amount specified as "Maximum" in the SCC.

27. Defect Liability

27.1 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.

27.2 The Defect Liability Period shall be 540 days from the date of Completion of the Facilities (or any part thereof) or 1 year from the date of Operational Acceptance of the Facilities (or any part thereof), whichever first occurs, unless specified otherwise in the SCC pursuant to GCC Subclause 27.10.

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 Employer 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 Employer,

(b) operation of the Facilities outside specifications provided in the Contract, or

(c) normal wear and tear.

27.3 The Contractor's obligations under this GCC Clause 27 shall not apply to:

(a) any materials that are supplied by the Employer under GCC Subclause 21.2, 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 Employer 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 Employer, except for the work executed by the Employer under GCC Subclause 27.7.

27.4 The Employer 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 Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect.

27.5 The Employer 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 27.

The Contractor may, with the consent of the Employer, 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.

27.6 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 Employer 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 Employer and the Contractor.

27.7 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 15 days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.

27.8 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 Employer because of any of the aforesaid reasons.

27.9 Except as provided in GCC Clauses 27 and 33, 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, criminal, or willful action of the Contractor.

27.10 In addition, any such component of the Facilities and during the period of time as may be specified in the SCC 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 Subclause 27.2.

28. Functional Guarantees

28.1 The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement, subject to, and upon the conditions therein specified.

28.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in the Appendix (Functional

Guarantees) to the Contract Agreement 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 Employer upon completion of the necessary changes, modifications, and/or additions, and shall request the Employer 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 Employer may consider termination of the Contract, pursuant to GCC Subclause 42.2.2.

28.3 If, for reasons attributable to the Contractor, the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement 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 Employer to repeat the Guarantee Test or

(b) pay liquidated damages to the Employer in respect of the failure to meet the Functional Guarantees in accordance with the provisions in the Appendix (Functional Guarantees) to the Contract Agreement.

28.4 The payment of liquidated damages under GCC Subclause 28.3, up to the limitation of liability specified in the Appendix (Functional Guarantees) to the Contract Agreement, shall completely satisfy the Contractor's guarantees under GCC Subclause 28.3, and the Contractor shall have no further liability whatsoever to the Employer 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.

29. Patent Indemnity

29.1 The Contractor shall, subject to the Employer's compliance with GCC Subclause 29.2, indemnify and hold harmless the Employer 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 Employer 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.

29.2 If any proceedings are brought or any claim is made against the Employer arising out of the matters referred to in GCC Subclause 29.1, the Employer shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Employer'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 Employer within 28 days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the 28-day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Employer 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.

29.3 The Employer 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 Employer.

30. Limitation of Liability

30.1 Except in cases of criminal negligence or willful misconduct,

(a) the Contractor shall not be liable to the Employer, 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 Employer, and

(b) the aggregate liability of the Contractor to the Employer, whether under the Contract, in tort or otherwise, shall not exceed a multiple of the Contract Price specified in the SCC or, if a multiple 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 Employer with respect to patent infringement.

G. Risk Distribution

31. Transfer of Ownership

31.1 Ownership of the Plant (including spare parts) to be imported into the country where the Site is located shall be transferred to the Employer upon loading on to the mode of transport to be used to convey the

Plant from the country of origin to that country.

31.2 Ownership of the Plant (including spare parts) procured in the country where the Site is located shall be transferred to the Employer when the Plant are brought on to the Site.

31.3 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.

31.4 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 Employer and the Contractor agree that the Plant in question are no longer required for the Facilities.

31.5 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 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant are incorporated.

32. Care of Facilities

32.1 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 24 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 27. 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 Subclauses 32.2 and 38.1.

32.2 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 34 hereof; or

(b) any use or occupation by the Employer or any third party other than a Subcontractor, authorized by the Employer 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 Employer, or any such matter for which the Contractor has disclaimed

responsibility herein,

the Employer 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 Employer 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 Employer in accordance with GCC Clause 39. If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with GCC Clause 39, 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 Employer shall terminate the Contract pursuant to GCC Subclause 42.1 hereof.

32.3 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 Subclause 32.2 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 Subclauses 32.2 (b) and (c) and 38.1.

32.4 With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in GCC Subclause 38.1, the provisions of GCC Subclause 38.3 shall apply.

33. Loss of or Damage to Property; Accident or Injury to Workers; Indemnification

33.1 Subject to GCC Subclause 33.3, the Contractor shall indemnify and hold harmless the Employer 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 Employer, its contractors, employees, officers, or agents.

33.2 If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Subclause 33.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer'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 Employer within 28 days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the 28-day period, the Employer shall make no admission that may be

prejudicial to the defense of any such proceedings or claim.

The Employer 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.

33.3 The Employer 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 Employer, 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 34, provided that such fire, explosion, or other perils were not caused by any act or failure of the Contractor.

33.4 The party entitled to the benefit of an indemnity under this GCC Clause 33 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.

34. Insurance

34.1 To the extent specified in the Appendix (Insurance Requirements) to the Contract Agreement, 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 Employer, who should not unreasonably withhold such approval.

(a) Cargo Insurance During Transport

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) 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.

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties including the Employer's personnel, and loss of or damage to property occurring in connection with the supply and installation of the Facilities.

(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 execution of the Contract.

(e) Workers' Compensation

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

(f) Employer's Liability

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

(g) Other Insurances

Such other insurances as may be specifically agreed upon by the parties hereto as listed in the Appendix (Insurance Requirements) to the Contract Agreement.

34.2 The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Subclause 34.1, except for the Third Party Liability, Workers' Compensation, and Employer'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 Subclause 34.1 except for the Cargo Insurance During Transport, Workers' Compensation, and Employer'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.

34.3 The Contractor shall, in accordance with the provisions of the Appendix (Insurance Requirements) to the Contract Agreement, deliver to the Employer 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 21 days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy.

34.4 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.

34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in the Appendix (Insurance Requirements) to the Contract Agreement, 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-insureds under all such policies. All insurers' 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. The Employer 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 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 Employer shall provide copies of the policies taken out by the Employer under this GCC Subclause 34.5.

34.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Subclause 34.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the insurances referred to in GCC 34.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Employer 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 Employer. 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 Employer, and the Contractor shall have full recourse against the Employer for any and all liabilities of the Employer herein.

34.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies effected by it pursuant to this GCC Clause 34, and all monies payable by any insurers shall be paid to the Contractor. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Employer'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 Employer. With respect to insurance claims in which the Contractor's interest is involved, the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.

35. Unforeseen Conditions

35.1 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 Employer, 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 of

(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 Subclause 35.1, the Project Manager shall promptly consult with the Employer 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 Employer, of the actions to be taken.

35.2 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 Subclause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price.

35.3 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 Subclause 35.1, the Time for Completion shall be extended in accordance with GCC Clause 40.

36. Change in Laws and Regulations

36.1 If, after the date 28 days prior to the date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated, or changed, which shall be deemed to include any change in interpretation or application by the competent authorities, that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with the SCC, pursuant to GCC Subclause 11.2.

37. Force Majeure

37.1 "Force Majeure" shall mean any event beyond the reasonable control of the Employer or of the Contractor, as the case may be, and which is unavoidable notwithstanding the reasonable care of the party affected, and shall include, without limitation, the following:

(a) war, hostilities, or warlike operations whether a state of war be declared or not, invasion, act of foreign enemy and civil war;

(b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion, and terrorist acts;

(c) confiscation, nationalization, mobilization, commandeering or requisition by or under the order of any government or de jure or de facto authority or ruler or any other act or failure to act of any local state or national government authority;

(d) strike, sabotage, lockout, embargo, import restriction, port congestion, lack of usual means of public transportation and communication, industrial dispute, shipwreck, shortage or

restriction of power supply, epidemics, quarantine, and plague;

(e) earthquake, landslide, volcanic activity, fire, flood or inundation, tidal wave, typhoon or cyclone, hurricane, storm, lightning, or other inclement weather condition, nuclear, and pressure waves or other natural or physical disaster; and

(f) shortage of labor, materials, or utilities where caused by circumstances that are themselves Force Majeure.

37.2 If either party is prevented, hindered, or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within 14 days after the occurrence of such event.

37.3 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered, or delayed. The Time for Completion shall be extended in accordance with GCC Clause 40.

37.4 The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to terminate the Contract under GCC Subclauses 37.6 and 38.5.

37.5 No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall

(a) constitute a default or breach of the Contract; or

(b) give rise to any claim for damages or additional cost or expense occasioned thereby, subject to GCC Subclauses 32.2, 38.3 and 38.4

if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure.

37.6 If the performance of the Contract is substantially prevented, hindered, or delayed for a single period of more than 60 days or an aggregate period of more than 120 days on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other, but without prejudice to either party's right to terminate the Contract under GCC Subclause 38.5.

37.7 In the event of termination pursuant to GCC Subclause 37.6, the rights and obligations of the Employer and the Contractor shall be as specified in GCC Subclauses 42.1.2 and 42.1.3.

37.8 Notwithstanding GCC Subclause 37.5, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor herein.

38. War Risks

38.1 "War Risks" shall mean any event specified in paragraphs (a) and (b) of GCC Subclause 37.1 and any explosion or impact of any mine, bomb, shell, grenade, or other projectile, missile, munitions or explosive of war, occurring or existing in or near the country (or countries) where the Site is located.

38.2 Notwithstanding anything contained in the Contract, the Contractor shall have no liability whatsoever for or with respect to

(a) destruction of or damage to Facilities, Plant, or any part thereof;

(b) destruction of or damage to property of the Employer or any third party; or

(c) injury or loss of life

if such destruction, damage, injury or loss of life is caused by any war risks, and the Employer shall indemnify and hold the Contractor harmless from and against any and all claims, liabilities, actions, lawsuits, damages, costs, charges, or expenses arising in consequence of or in connection with the same.

38.3 If the Facilities or any Plant or Contractor's Equipment or any other property of the Contractor used or intended to be used for the purposes of the Facilities shall sustain destruction or damage by reason of any war risks, the Employer shall pay the Contractor for

(a) any part of the Facilities or the Plant so destroyed or damaged to the extent not already paid for by the Employer and so far as may be required by the Employer, and as may be necessary for completion of the Facilities;

(b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged; and

(c) replacing or making good any such destruction or damage to the Facilities or the Plant or any part thereof.

If the Employer does not require the Contractor to replace or make good any such destruction or damage to the Facilities, the Employer shall either request a change in accordance with GCC Clause 39, excluding the performance of that part of the Facilities thereby destroyed or damaged or, where the loss, destruction, or damage affects a substantial part of the Facilities, shall terminate the Contract, pursuant to GCC Subclause 42.1.

If the Employer requires the Contractor to replace or make good on any such destruction or damage to the Facilities, the Time for Completion shall be extended in accordance with GCC 40.

38.4 Notwithstanding anything contained in the Contract, the Employer shall pay the Contractor for any increased costs or incidentals to the execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any war risks, provided that the Contractor shall as soon as practicable notify the Employer in writing of any such increased cost.

38.5 If during the performance of the Contract any war risks shall occur that

financially or otherwise materially affect the execution of the Contract by the Contractor, the Contractor shall use its reasonable efforts to execute the Contract with due and proper consideration given to the safety of its and its Subcontractors' personnel engaged in the work on the Facilities, provided, however, that if the execution of the work on the Facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of any war risks, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other.

38.6 In the event of termination pursuant to GCC Subclauses 38.3 or 38.5, the rights and obligations of the Employer and the Contractor shall be specified in GCC Subclauses 42.1.2 and 42.1.3.

H. Change in Contract Elements

39. Change in the Facilities

39.1 Introducing a Change

39.1.1 Subject to GCC Subclauses 39.2.5 and 39.2.7, the Employer 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.

39.1.2 The Contractor may from time to time during its performance of the Contract propose to the Employer 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 Employer may at its discretion approve or reject any Change proposed by the Contractor, provided that the Employer shall approve any Change proposed by the Contractor to ensure the safety of the Facilities.

39.1.3 Notwithstanding GCC Subclauses 39.1.1 and 39.1.2, 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.

39.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Subclauses 39.2 and 39.3, and further details and forms are provided in the Employer's Requirements (Forms and Procedures).

39.2 Changes Originating from Employer

39.2.1 If the Employer proposes a Change pursuant to GCC Subclause 39.1.1, 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, and

(f) effect on any other provisions of the Contract.

39.2.2 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 Employer 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 Employer does not intend to proceed with the Change.

39.2.3 Upon receipt of the Employer's instruction to proceed under GCC Subclause 39.2.2 (a), the Contractor shall, with proper expedition, proceed with the preparation of the Change Proposal, in accordance with GCC Subclause 39.2.1.

39.2.4 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.

39.2.5 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 39 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 15%, the Contractor may give a written notice of objection thereto prior to furnishing the Change Proposal as aforesaid. If the Employer accepts the Contractor's objection, the Employer 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.

39.2.6 Upon receipt of the Change Proposal, the Employer and the Contractor shall mutually agree upon all matters therein contained. Within 14 days after such agreement, the Employer shall, if it intends to proceed with the Change, issue the Contractor with a Change Order.

If the Employer is unable to reach a decision within 14 days, it shall notify the Contractor with details of when the Contractor can expect a decision.

If the Employer decides not to proceed with the Change for whatever reason, it shall, within the said period of 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 Subclause 39.2.2.

39.2.7 If the Employer 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 Employer 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.

If the parties cannot reach agreement within 60 days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Dispute Board in accordance with the provisions of GCC Subclause 45.3.

39.3 Changes Originating from Contractor

39.3.1 If the Contractor proposes a Change pursuant to GCC Subclause 39.1.2, 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 Subclause 39.2.1.

Upon receipt of the Application for Change Proposal, the parties

shall follow the procedures outlined in GCC Subclauses 39.2.6 and 39.2.7. However, should the Employer choose not to proceed, the Contractor shall not be entitled to recover the costs of preparing the Application for Change Proposal.

40. Extension of Time for Completion

40.1 The Time(s) for Completion specified in the SCC 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 39;

(b) any occurrence of Force Majeure as provided in GCC Clause 37, unforeseen conditions as provided in GCC Clause 35, or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Subclause 32.2;

(c) any suspension order given by the Employer under GCC Clause 41 hereof or reduction in the rate of progress pursuant to GCC Subclause 41.2; or

(d) any changes in laws and regulations as provided in GCC Clause 36; or

(e) any default or breach of the Contract by the Employer, or any activity, act or omission of the Employer, or the Project Manager, or any other contractors employed by the Employer; or

(f) any other matter specifically mentioned in the Contract; or

(g) 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 Subclause

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.

40.2 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 Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to a Dispute Board, pursuant to GCC Subclause 45.3.

40.3 The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.

In all cases where the Contractor has given a notice of a claim for an extension of time under GCC 40.2, 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 40.1, the amount of such extra costs shall be added to the Contract Price.

41. Suspension

41.1 The Employer 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 therefor. 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 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 Employer shall, within 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 39, excluding the performance of the suspended obligations from the Contract.

If the Employer 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 39 or, where it affects the whole of the Facilities, as termination of the Contract under GCC Subclause 42.1.

41.2 If

(a) the Employer 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 (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in GCC Subclause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer 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 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 Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with GCC Subclause 10.2, or failure to obtain any governmental permit

necessary for the execution and/or completion of the Facilities,

then the Contractor may by 14 days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.

41.3 If the Contractor's performance of its obligations is suspended, or the rate of progress is reduced pursuant to this GCC Clause 41, then the Time for Completion shall be extended in accordance with GCC Subclause 40.1, 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 Employer 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.

41.4 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 Employer.

42. Termination

42.1 Termination for Employer's Convenience

42.1.1 The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this GCC Subclause 42.1.

42.1.2 Upon receipt of the notice of termination under GCC Subclause 42.1.1, the Contractor shall, either immediately or upon the date specified in the notice of termination,

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition;

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) (ii) below;

(c) remove all Contractor's Equipment from the Site, repatriate the Contractor's and its Subcontractors' personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition; and

(d) subject to the payment specified in GCC Subclause 42.1.3,

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination;

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors; and

(iii) deliver to the Employer all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of

termination in connection with the Facilities.

42.1.3 In the event of termination of the Contract under GCC Subclause 42.1.1, the Employer shall pay to the Contractor the following amounts:

(a) the Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as of the date of termination;

(b) the costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors' personnel;

(c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges;

(d) costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Subclause 42.1.2; and

(e) the cost of satisfying all other obligations, commitments and claims that the Contractor may in good faith have undertaken with third parties in connection with the Contract and that are not covered by paragraphs (a) through (d) above.

42.2 Termination for Contractor's Default

42.2.1 The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefor to the Contractor, referring to this GCC Subclause 42.2:

(a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up, other than a voluntary liquidation for the purposes of amalgamation or reconstruction, a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt;

(b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of GCC Clause 43; and

(c) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices, as defined in GCC Clause 6, in competing for or in executing the Contract.

42.2.2 If the Contractor

(a) has abandoned or repudiated the Contract;

(b) has without valid reason failed to commence work on the Facilities promptly or has suspended, other than pursuant to GCC Subclause 41.2, the progress of Contract performance for more than 28 days after receiving a written instruction from the Employer to proceed;

(c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause;

(d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished under GCC Subclause 18.2 at rates of progress that give reasonable assurance to the Employer that the Contractor can attain Completion of the Facilities by the Time for Completion as extended;

then the Employer may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor, stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within 14 days of its receipt of such notice, then the Employer may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this GCC Subclause 42.2.

42.2.3 Upon receipt of the notice of termination under GCC Subclauses 42.2.1 or 42.2.2, the Contractor shall, either immediately or upon such date as is specified in the notice of termination,

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition;

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below;

(c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination;

(d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors; and

(e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection

with the Facilities.

42.2.4 The Employer may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third party. The Employer may, to the exclusion of any right of the Contractor over the same, take over and use with the payment of a fair rental rate to the Contractor, with all the maintenance costs to the account of the Employer and with an indemnification by the Employer for all liability including damage or injury to persons arising out of the Employer's use of such equipment, any Contractor's Equipment owned by the Contractor and on the Site in connection with the Facilities for such reasonable period as the Employer considers expedient for the supply and installation of the Facilities.

Upon completion of the Facilities or at such earlier date as the Employer thinks appropriate, the Employer shall give notice to the Contractor that such Contractor's Equipment will be returned to the Contractor at or near the Site and shall return such Contractor's Equipment to the Contractor in accordance with such notice. The Contractor shall thereafter without delay and at its cost remove or arrange removal of the same from the Site.

42.2.5 Subject to GCC Subclause 42.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as of the date of termination, the value of any unused or partially used Plant on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Subclause 42.2.3. Any sums due the Employer from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid to the Contractor under this Contract.

42.2.6 If the Employer completes the Facilities, the cost of completing the Facilities by the Employer shall be determined.

If the sum that the Contractor is entitled to be paid, pursuant to GCC Subclause 42.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess.

If such excess is greater than the sums due the Contractor under GCC Subclause 42.2.5, the Contractor shall pay the balance to the Employer, and if such excess is less than the sums due the Contractor under GCC Subclause 42.2.5, the Employer shall pay the balance to the Contractor.

The Employer and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid.

42.3 Termination by Contractor

42.3.1 If

(a) the Employer 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 (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in GCC Subclause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer 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, fails to remedy the breach or take steps to remedy the breach within 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 Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities;

then the Contractor may give a notice to the Employer thereof, and if the Employer has failed to pay the outstanding sum, to approve the invoice or supporting documents, to give its reasons for withholding such approval, or to remedy the breach within 28 days of such notice, or if the Contractor is still unable to carry out any of its obligations under the Contract for any reason attributable to the Employer within 28 days of the said notice, the Contractor may by a further notice to the Employer referring to this GCC Subclause 42.3.1, forthwith terminate the Contract.

42.3.2 The Contractor may terminate the Contract forthwith by giving a notice to the Employer to that effect, referring to this GCC Subclause 42.3.2, if the Employer becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, being a corporation, if a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Employer takes or suffers any other analogous action in consequence of debt.

42.3.3 If the Contract is terminated under GCC Subclauses 42.3.1 or 42.3.2, then the Contractor shall immediately

(a) cease all further work, except for such work as may be necessary for the purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition;

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) (ii);

(c) remove all Contractor's Equipment from the Site and repatriate the Contractor's and its Subcontractors'

personnel from the Site; and

(d) subject to the payment specified in GCC Subclause 42.3.4,

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination;

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors; and

(iii) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.

42.3.4 If the Contract is terminated under GCC Subclauses 42.3.1 or 42.3.2, the Employer shall pay to the Contractor all payments specified in GCC Subclause 42.1.3, and reasonable compensation for all loss, except for loss of profit, or damage sustained by the Contractor arising out of, in connection with or in consequence of such termination.

42.3.5 Termination by the Contractor pursuant to this GCC Subclause 42.3 is without prejudice to any other rights or remedies of the Contractor that may be exercised in lieu of or in addition to rights conferred by GCC Subclause 42.3.

42.4 In this GCC Clause 42, the expression “Facilities executed” shall include all work executed, Installation Services provided, and all Plant acquired, or subject to a legally binding obligation to purchase, by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination.

42.5 In this GCC Clause 42, in calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to the Appendix (Terms and Procedures of Payment) to the Contract Agreement.

43. Assignment

43.1 Neither the Employer nor the Contractor shall, without the express prior written consent of the other party which consent shall not be unreasonably withheld, assign to any third party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may become due and payable to it under the Contract.

I. Claims, Disputes, and Arbitration

44. Contractor's Claims

44.1 If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall submit a notice to the Project Manager, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Subclause shall apply.

The Contractor shall also submit any other notices, which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Project Manager. Without admitting the Employer's liability, the Project Manager may, after receiving any notice under this Subclause, monitor the record keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Project Manager to inspect all these records, and shall (if instructed) submit copies to the Project Manager.

Within 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 Project Manager, the Contractor shall send to the Project Manager 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. If the event or circumstance giving rise to the claim has a continuing effect,

(a) this fully detailed claim shall be considered as interim;

(b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Project Manager may reasonably require; and

(c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Project Manager.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Project Manager and approved by the Contractor, the Project Manager shall respond with approval, or with disapproval and

detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each payment certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Project Manager shall agree with the Contractor or estimate: (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with GCC Clause 40, and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Subclause are in addition to those of any other Subclause, which may apply to a claim. If the Contractor fails to comply with this or another Subclause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Subclause.

In the event that the Contractor and the Employer cannot agree on any matter relating to a claim, either party may refer the matter to the Dispute Board pursuant to GCC 45 hereof.

45. Disputes and Arbitration

45.1 Appointment of the Dispute Board

Disputes shall be referred to a Dispute Board for decision in accordance with GCC Subclause 45.3. The Parties shall appoint a Dispute Board by the date stated in the SCC.

The Dispute Board shall comprise, as stated in the SCC, either one or three suitably qualified persons ("the members"), each of whom shall be fluent in the language for communication defined in the Contract and shall be a professional experienced in the type of activities involved in the performance of the Contract and with the interpretation of contractual documents. If the number is not so stated and the Parties do not agree otherwise, the Dispute Board shall comprise three persons, one of whom shall serve as chairman.

If the Parties have not jointly appointed the Dispute Board 21 days before the date stated in the SCC and the Dispute Board is to comprise three persons, each Party shall nominate one member for the approval of the other Party. The first two members shall recommend and the Parties shall agree upon the third member, who shall act as chairman.

However, if a list of potential members is included in the SCC, the members shall be selected from those on the list, other than anyone who is unable or unwilling to accept appointment to the Dispute Board.

The agreement between the Parties and either the sole member or

each of the three members shall incorporate by reference the General Conditions of Dispute Board Agreement contained in the Appendix to these General Conditions, with such amendments as are agreed between them.

The terms of the remuneration of either the sole member or each of the three members, including the remuneration of any expert whom the Dispute Board consults, shall be mutually agreed upon by the Parties when agreeing the terms of appointment of the member or such expert (as the case may be). Each Party shall be responsible for paying one- half of this remuneration.

If a member declines to act or is unable to act as a result of death, disability, resignation or termination of appointment, a replacement shall be appointed in the same manner as the replaced person was required to have been nominated or agreed upon, as described in this Subclause.

The appointment of any member may be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. Unless otherwise agreed by both Parties, the appointment of the Dispute Board (including each member) shall expire when the Operational Acceptance Certificate has been issued in accordance with GCC Clause 25.3.

45.2 Failure to Agree Dispute Board

If any of the following conditions apply, namely:

(a) the Parties fail to agree upon the appointment of the sole member of the Dispute Board by the date stated in the first paragraph of GCC Subclause 45.1;

(b) either Party fails to nominate a member (for approval by the other Party) of a Dispute Board of three persons by such date;

(c) the Parties fail to agree upon the appointment of the third member (to act as chairman) of the Dispute Board by such date; or

(d) the Parties fail to agree upon the appointment of a replacement person within 42 days after the date on which the sole member or one of the three members declines to act or is unable to act as a result of death, disability, resignation, or termination of appointment;

then the appointing entity or official named in the SCC shall, upon the request of either or both of the Parties and after due consultation with both Parties, appoint this member of the Dispute Board. This appointment shall be final and conclusive. Each Party shall be responsible for paying one-half of the remuneration of the appointing entity or official.

45.3 Obtaining Dispute Board's Decision

If a dispute (of any kind whatsoever) arises between the Parties in connection with the performance of the Contract, including any dispute

as to any certificate, determination, instruction, opinion or valuation of the Project Manager, either Party may refer the dispute in writing to the Dispute Board for its decision, with copies to the other Party and the Project Manager. Such reference shall state that it is given under this Subclause.

For a Dispute Board of three persons, the Dispute Board shall be deemed to have received such reference on the date when it is received by the chairman of the Dispute Board.

Both Parties shall promptly make available to the Dispute Board all such additional information, further access to the Site, and appropriate facilities, as the Dispute Board may require for the purposes of making a decision on such dispute. The Dispute Board shall be deemed to be not acting as arbitrator(s).

Within 84 days after receiving such reference, or within such other period as may be proposed by the Dispute Board and approved by both Parties, the Dispute Board shall give its decision, which shall be reasoned and shall state that it is given under this Subclause. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the performance of the Facilities in accordance with the Contract.

If either Party is dissatisfied with the Dispute Board's decision, then either Party may, within 28 days after receiving the decision, give notice to the other Party of its dissatisfaction and intention to commence arbitration. If the Dispute Board fails to give its decision within the period of 84 days (or as otherwise approved) after receiving such reference, then either Party may, within 28 days after this period has expired, give notice to the other Party of its dissatisfaction and intention to commence arbitration.

In either event, this notice of dissatisfaction shall state that it is given under this Subclause, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in GCC Subclauses 45.6 and 45.7, neither Party shall be entitled to commence arbitration of a dispute unless a notice of dissatisfaction has been given in accordance with this Subclause.

If the Dispute Board has given its decision as to a matter in dispute to both Parties, and no notice of dissatisfaction has been given by either Party within 28 days after it received the Dispute Board's decision, then the decision shall become final and binding upon both Parties.

45.4 Amicable Settlement

Where notice of dissatisfaction has been given under GCC Subclause 45.3 above, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, arbitration may be commenced on or after the fifty- sixth day after the day on which notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable

settlement has been made.

45.5 Arbitration

Unless settled amicably, any dispute in respect of which the Dispute Board's decision (if any) has not become final and binding shall be finally settled by international arbitration. Unless otherwise agreed by both Parties,

(a) arbitration proceedings shall be conducted as stated in the Special Conditions;

(b) if no arbitration proceedings is so stated, the dispute shall be finally settled by institutional arbitration under the Rules of Arbitration of the International Chamber of Commerce;

(c) the dispute shall be settled by three arbitrators; and

(d) the arbitration shall be conducted in the language for communications defined in GCC Subclause 5.3.

The arbitrator(s) shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Project Manager, and any decision of the Dispute Board, relevant to the dispute. Nothing shall disqualify the Project Manager from being called as a witness and giving evidence before the arbitrator(s) on any matter whatsoever relevant to the dispute.

Neither Party shall be limited in the proceedings before the arbitrator(s) to the evidence or arguments previously put before the Dispute Board to obtain its decision, or to the reasons for dissatisfaction given in its notice of dissatisfaction. Any decision of the Dispute Board shall be admissible in evidence in the arbitration.

Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Project Manager and the Dispute Board shall not be altered by reason of any arbitration being conducted during the progress of the Works.

45.6 Failure to Comply with Dispute Board's Decision

In the event that a Party fails to comply with a Dispute Board decision which has become final and binding, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under GCC Subclause 45.5. GCC Subclauses 45.3 and 45.4 shall not apply to this reference.

45.7 Expiry of Dispute Board's Appointment

If a dispute arises between the Parties in connection with the performance of the Contract, and there is no Dispute Board in place, whether by reason of the expiry of the Dispute Board's appointment or otherwise,

(a) GCC Subclauses 45.3 and 45.4 shall not apply, and

(b) the dispute may be referred directly to arbitration under GCC Subclause 45.5.

APPENDIX A

General Conditions of Dispute Board Agreement

1 Definitions

Each “Dispute Board Agreement” is a tripartite agreement by and between

(a) the “Employer”;

(b) the “Contractor”; and

(c) the “Member” who is defined in the Dispute Board Agreement as being

(i) the sole member of the "Dispute Board" and, where this is the case, all references to the “Other Members” do not apply; or

(ii) one of the three persons who are jointly called the “Dispute Board” and, where this is the case, the other two persons are called the “Other Members”.

The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Dispute Board Agreement, which incorporates this Appendix. In the Dispute Board Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract.

2 General Provisions

Unless otherwise stated in the Dispute Board Agreement, it shall take effect on the latest of the following dates:

(a) the Commencement Date defined in the Contract;

(b) when the Employer, the Contractor and the Member have each signed the Dispute Board Agreement; or

(c) when the Employer, the Contractor and each of the Other Members (if any) have respectively each signed a dispute board agreement.

This employment of the Member is a personal appointment. At any time, the Member may give not less than 70 days’ notice of resignation to the Employer and to the Contractor, and the Dispute Board Agreement shall terminate upon the expiry of this period.

3 Warranties

The Member warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Project Manager. The Member shall promptly disclose, to each of them and to the Other Members (if any), any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence.

When appointing the Member, the Employer and the Contractor relied upon the Member’s representations that he/she is

(a) experienced in the work, which the Contractor is to carry out under the Contract,

(b) experienced in the interpretation of contract documentation, and

(c) fluent in the language for communications defined in the Contract.

4 General Obligations of the Member

The Member shall

(a) have no interest financial or otherwise in the Employer, the Contractor or the Project Manager, nor any financial interest in the Contract except for payment under the Dispute Board Agreement;

(b) not previously have been employed as a consultant or otherwise by the Employer, the Contractor, or the Project Manager, except in such circumstances as were disclosed in writing to the Employer and the Contractor before they signed the Dispute Board Agreement;

(c) have disclosed in writing to the Employer, the Contractor, and the Other Members (if any), before entering into the Dispute Board Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer, or employee of the Employer, the Contractor, or the Project Manager, and any previous involvement in the overall project of which the Contract forms part;

(d) not, for the duration of the Dispute Board Agreement, be employed as a consultant or otherwise by the Employer, the Contractor, or the Project Manager, except as may be agreed in writing by the Employer, the Contractor, and the Other Members (if any);

(e) comply with the annexed procedural rules and with GCC Subclause 45.3;

(f) not give advice to the Employer, the Contractor, the Employer's Personnel, or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules;

(g) not while a Member enter into discussions or make any agreement with the Employer, the Contractor, or the Project Manager regarding employment by any of them, whether as a consultant or otherwise, after ceasing to act under the Dispute Board Agreement;

(h) ensure his/her availability for all site visits and hearings as are necessary;

(i) become conversant with the Contract and with the progress of the Facilities (and of any other parts of the project of which the Contract forms part) by studying all documents received, which shall be maintained in a current working file;

(j) treat the details of the Contract and all the Dispute Board's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer, the Contractor, and the Other Members (if any); and

(k) be available to give advice and opinions on any matter relevant to the Contract when requested by both the Employer and the Contractor, subject to the agreement of the Other Members (if any).

5 General Obligations of the Employer and the Contractor

The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Member regarding the Contract, otherwise than in the normal course of the Dispute Board's activities under the Contract and the Dispute Board Agreement. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively.

The Employer and the Contractor undertake to each other and to the Member that the Member shall not, except as otherwise agreed in writing by the Employer, the Contractor, the Member and the Other Members (if any)

(a) be appointed as an arbitrator in any arbitration under the Contract;

(b) be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or

(c) be liable for any claims for anything done or omitted in the discharge or purported discharge of the Member's functions, unless the act or omission is shown to have been in bad faith.

The Employer and the Contractor hereby jointly and severally indemnify and hold the Member harmless against and from claims from which he is relieved from liability under the preceding paragraph.

Whenever the Employer or the Contractor refers a dispute to the Dispute Board under GCC Subclause 45.3, which will require the Member to make a site visit and attend a hearing, the Employer or the Contractor shall provide appropriate security for a sum equivalent to the reasonable expenses to be incurred by the Member. No account shall be taken of any other payments due or paid to the Member.

6 Payment

The Member shall be paid as follows, in the currency named in the Dispute Board Agreement:

(a) a retainer fee per calendar month, which shall be considered as payment in full for

(i) being available on 28 days' notice for all site visits and hearings;

(ii) becoming and remaining conversant with all project developments and maintaining relevant files;

(iii) all office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties; and

(iv) all services performed hereunder except those referred to in sub-paragraphs (b) and (c) of this Clause.

The retainer fee shall be paid with effect from the last day of the calendar month in which the Dispute Board Agreement becomes effective; until the last day of the calendar month in which the Taking-Over Certificate is issued for the whole of the Works.

With effect from the first day of the calendar month following the month in which Taking-Over Certificate is issued for the whole of the Works, the retainer fee shall be reduced by one-third.

This reduced fee shall be paid until the first day of the calendar month in which the Member resigns or the Dispute Board Agreement is otherwise terminated.

(b) a daily fee, which shall be considered as payment in full for

(i) each day or part of a day up to a maximum of 2 days' travel time in each direction for the journey between the Member's home and the site, or another location of a meeting with the Other Members (if any);

(ii) each working day on site visits, hearings, or preparing decisions; and

(iii) each day spent reading submissions in preparation for a hearing.

(c) all reasonable expenses, including necessary travel expenses (air fare in less than first class, hotel and subsistence and other direct travel expenses) incurred in connection with the Member's duties, as well as the cost of telephone calls, courier charges, facsimiles, and telexes, and use of the internet: a receipt shall be required for each item in excess of 5% of the daily fee referred to in sub-paragraph (b) of this Clause;

(d) any taxes properly levied in the Country on payments made to the Member (unless a national or permanent resident of the Country) under this Clause 6.

The retainer and daily fees shall be as specified in the Dispute Board Agreement. Unless it specifies otherwise, these fees shall remain fixed for the first 24 calendar months, and shall thereafter be adjusted by agreement between the Employer, the Contractor and the Member, at each anniversary of the date on which the Dispute Board Agreement became effective.

If the parties fail to agree on the retainer fee or the daily fee, the appointing entity or official named in the SCC shall determine the amount of the fees to be used.

The Member shall submit invoices for payment of the monthly retainer and air fares quarterly in advance. Invoices for other expenses and for daily fees shall be submitted following the conclusion of a site visit or hearing. All invoices shall be accompanied by a brief description of activities performed during the relevant period and shall be addressed to the Contractor.

The Contractor shall pay each of the Member's invoices in full within 56 calendar days after receiving each invoice and shall apply to the Employer (in the Statements under the Contract) for reimbursement of one-half of the amounts of these invoices. The Employer shall then pay the Contractor in accordance with the Contract.

If the Contractor fails to pay to the Member the amount to which he/she is entitled under the Dispute Board Agreement, the Employer shall pay the amount due to the Member and any other amount which may be required to maintain the operation of the Dispute Board; and without prejudice to the Employer's rights or remedies. In addition to all other rights arising from this default, the Employer shall be entitled to reimbursement of all sums paid in excess of one- half of these payments, plus all costs of recovering these sums and financing charges calculated at the rate specified in accordance with GCC Subclause 12.3.

If the Member does not receive payment of the amount due within 70 days after submitting a valid invoice, the Member may (i) suspend his/her services (without notice) until the payment is received, and/or (ii) resign his/her appointment by giving notice under Clause 7.

7 Termination

At any time: (i) the Employer and the Contractor may jointly terminate the Dispute Board Agreement by giving 42 days' notice to the Member, or (ii) the Member may resign as provided for in Clause 2.

If the Member fails to comply with the Dispute Board Agreement, the Employer and the Contractor may, without prejudice to their other rights, terminate it by notice to the Member. The notice shall take effect when received by the Member.

If the Employer or the Contractor fails to comply with the Dispute Board Agreement, the Member may, without prejudice to his other rights, terminate it by notice to the Employer and the Contractor. The notice shall take effect when received by them both.

Any such notice, resignation and termination shall be final and binding on the Employer, the Contractor and the Member. However, a notice by the Employer or the Contractor, but not by both, shall be of no effect.

8 Default of the Member

If the Member fails to comply with any of his obligations under Clause 4 concerning his impartiality or independence in relation to the Employer or the Contractor, he/she shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the Member and the Other Members (if any), for proceedings or decisions (if any) of the Dispute Board which are rendered void or ineffective by the said failure to comply.

9 Disputes

Any dispute or claim arising out of or in connection with this Dispute Board Agreement, or the breach, termination or invalidity thereof, shall be finally settled by institutional arbitration. If no other arbitration institute is agreed, the arbitration shall be conducted under the Rules of Arbitration of the International Chamber of Commerce by one arbitrator appointed in accordance with these Rules of Arbitration.

Annex - DISPUTE BOARD GUIDELINES

1. Unless otherwise agreed by the Employer and the Contractor, the Dispute Board shall visit the site at intervals of not more than 140 days, including times of critical construction events, at the request of either the Employer or the Contractor. Unless otherwise agreed by the Employer, the Contractor, and the Dispute Board, the period between consecutive visits shall not be less than 70 days, except as required to convene a hearing as described below.

2. The timing of and agenda for each site visit shall be as agreed jointly by the Dispute Board, the Employer, and the Contractor, or in the absence of agreement, shall be decided by the Dispute Board. The purpose of site visits is to enable the Dispute Board to become and remain acquainted with the progress of the Works and of any actual or potential problems or claims, and, as far as reasonable, to prevent potential problems or claims from becoming disputes.

3. Site visits shall be attended by the Employer, the Contractor, and the Project Manager and shall be coordinated by the Employer in cooperation with the Contractor. The Employer shall ensure the provision of appropriate conference facilities and secretarial and copying services. At the conclusion of each site visit and before leaving the site, the Dispute Board shall prepare a report on its activities during the visit and shall send copies to the Employer and the Contractor.

4. The Employer and the Contractor shall furnish to the Dispute Board one copy of all documents which the Dispute Board may request, including Contract documents, progress reports, variation instructions, certificates, and other documents pertinent to the performance of the Contract. All communications between the Dispute Board and the Employer or the Contractor shall be copied to the other Party. If the Dispute Board comprises three persons, the Employer and the Contractor shall send copies of these requested documents and these communications to each of these persons.

5. If any dispute is referred to the Dispute Board in accordance with GCC Subclause 45.3, the Dispute Board shall proceed in accordance with GCC Subclause 45.3 and these Guidelines. Subject to the time allowed to give notice of a decision and other relevant factors, the Dispute Board shall

   (a) act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case; and

   (b) adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

6. The Dispute Board may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing.

7. Except as otherwise agreed in writing by the Employer and the Contractor, the Dispute Board shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor, and the Project Manager, and to proceed in the absence of any party who the Dispute Board is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised.

8. The Employer and the Contractor empower the Dispute Board, among other things, to

   (a) establish the procedure to be applied in deciding a dispute;

(b) decide upon the Dispute Board's own jurisdiction, and as to the scope of any dispute referred to it;

(c) conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Guidelines;

(d) take the initiative in ascertaining the facts and matters required for a decision;

(e) make use of its own specialist knowledge, if any;

(f) decide upon the payment of financing charges in accordance with the Contract;

(g) decide upon any provisional relief such as interim or conservatory measures;

(h) open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Project Manager, relevant to the dispute; and

(i) appoint, should the Dispute Board so consider necessary and the Parties agree, a suitable expert at the cost of the Parties to give advice on a specific matter relevant to the dispute.

9. The Dispute Board shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the Dispute Board shall make and give its decision in accordance with GCC Subclause 45.3, or as otherwise agreed by the Employer and the Contractor in writing. If the Dispute Board comprises three persons

(a) it shall convene in private after a hearing, in order to have discussions and prepare its decision;

(b) it shall endeavour to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and

(c) if a Member fails to attend a meeting or hearing, or to fulfil any required function, the other two Members may nevertheless proceed to make a decision, unless

(i) either the Employer or the Contractor does not agree that they do so, or

(ii) the absent Member is the chairman and he/she instructs the other Members to not make a decision.

Section 8 - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC. The clause number of the SCC is the corresponding clause number of the GCC.

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1. Definitions

The Employer is: Sri Lanka Sustainable Energy Authority

The Project Director is: Director General

No.72

Ananda Coomaraswamy Mawatha,

Colombo 07

The Bank is: Indian EXIM Bank

Country of Origin: The Government of India

5. Law and Language

5.1 The Contract shall be interpreted in accordance with the laws of: The Democratic Socialist Republic of Sri Lanka

5.2 The ruling language is: English Language

5.3 The language for communications is: English

7. Scope of Facilities

7.3 The Contractor agrees to supply spare parts for a period of years: 10 years

The Contractor shall carry sufficient inventories to ensure an ex-stock supply of consumable spares for the Plant. Other spare parts and components shall be supplied as promptly as possible, but at the most within 6 months of placing the order and opening the letter of credit. In addition, in the event of termination of the production of spare parts, advance notification will be made to the Employer of the pending termination, with sufficient time to permit the Employer to procure the needed requirement. Following such termination, the Contractor will furnish to the extent possible and at no cost to the Employer the blueprints, drawings and specifications of the spare parts, if requested.

8. Time for Commencement and Completion

8.1 The Contractor shall commence work on the Facilities within twenty eight (28) days from the Effective Date for determining Time for Completion as specified in the Contract Agreement.

8.2 The Time for Completion of the whole of the Facilities of all three Plants as specified in the Employer's Requirement shall be within 730 days from the Effective Date as described in the Contract Agreement

11. Contract Price

11.2 The Contract Price shall be adjusted in accordance with the provisions of Appendix 2 (Price Adjustment) to the Contract Agreement.

13. Securities

13.3.1 The amount of performance security for the whole of the Facilities of all three Plants as specified in the Employer's Requirement shall be: **10 % of the contract value.**

13.3.2 The performance security shall be in the form of the Bank Guarantee as per form included in Section 9 (Contract Forms).

13.3.3 The performance security shall not be reduced on the date of the Operational Acceptance.

14. Taxes and Duties

Add the following clauses

14.5 Income Tax

Foreign and Local Contractors and Construction Agencies of the Government will have to comply with regulations of the Department of Inland Revenue for payment of Income Tax on profits arising from the Contract. Foreign and Local Contractors and Construction Agencies of the Government shall be wholly responsible for the payment of all taxes which are payable under Revenue Laws of Sri Lanka.

14.6 Value Added Tax (VAT)

GOSL shall exempt Contractor's from payment of VAT, local Taxes, levies etc. on project related procurements.

14.7 Remittance Abroad

If a foreign Contractor wishes to remit out of Sri Lanka any of his earnings in Sri Lanka Rupees representing profits, foreign overheads, home allowances and salaries of foreign personnel, he will have to comply with regulations of the Department of Inland Revenue and of the Department of Exchange Control, Central Bank of Sri Lanka.

14.8 Exemption from Customs/ Import Duty

All Plants specified in "Price Schedule No. 01" and that are incorporated into the Facilities imported by the Contractor into the Country shall be exempt from customs, other import duties and VAT enforced on them, if the Employer's prior written approval is obtained for import. The Employer shall endorse the necessary exemption documents prepared by the Contractor for presentation in order to clear the such Plants through Customs, and shall also provide the following exemption documents:

i. Request for the Customs Duty Exemption addressed to Director General (Dept. of Trade, Tariff and Investment Policy), General Treasury.
ii. Request for the VAT Exemption addressed to Director General (Dept. of Fiscal Policy), General Treasury.

If exemption is not then granted, the customs/import duties and VAT payable shall be paid or reimbursed by the Employer.

14.9 Customs/ Import duty on Contractor's Equipment

For obtaining the exemption or the payment of customs, import duties and taxes on the constructional plant, equipment, tools, materials and vehicles which remain the property of the Contractor, and re-exported after completion of the works the Contractor shall provide the Employer with a Bank Guarantee equal to the value of duties and taxes paid, from a bank acceptable to the Employer. The Bank Guarantee shall be valid during the total period plus one month the items are in Sri Lanka. Any payments under this clause will be in Sri Lanka Rupees. Computation of the Employer's payments/reimbursements of such duties and taxes on such consignments will be limited to the CIF value.

14.10 Payment of Dues and Duties on Disposable Items

Notwithstanding the foregoing, the Contractor shall pay all the prescribed dues and charges including customs duties on all his constructional plant, equipment, tools, materials, appliances, vehicles, and other things, which he disposes of in the Island. After the Contractor receives the necessary authority for such disposal from the Employer, the dues and charges payable shall be assessed in the manner and at the rates applicable at the time of disposal. The Contractor and his personnel shall comply with the regulations of the Government, which may be issued from time to time relating to the disposal of items the import of which is under Government restrictions.

14.11 Landing Charges, Port Duties etc.

The Contractor shall bear all expenses in connection with the landing and shipment of all such plant & equipment, materials, constructional plant and other things brought into or dispatched from Sri Lanka including second warehouse rent, port and lighter dues and pilotage charges together with all handling and other charges, in respect of all such plant & equipment, materials, constructional plant and other things supplied by them.

18. Work Program

18.3 (c) monitoring of the obligations in sub-clauses 21.1, 22.1.1, 22.2.1, 22.2.4 ,22.2.15 and 22.2.16.

20. Design and Engineering

20.3.2 Sub-Clause 20.3.2 of Section 7: General Conditions of Contract is replaced as follows:**.**

Within twenty eight (28) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Sub-Clause 20.3.1, 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 therefore and the modifications that the Project Manager proposes.

If the Project Manager fails to take such action within the said twenty eight (28) days, then the said document shall be deemed to have been approved by the Project Manager.

21. Procurement

21.1 Materials

The following is added at the end of Sub-Clause 21.1 of Section 7 : General Conditions of Contract**:**

The contractor shall adequately record the condition of roads, agricultural land and other infrastructure prior to the start of transporting materials, goods and equipment, and construction.

22. Installation

22.2 Labour

22.2.1 Engagement of Staff and Labour

Add the following text after the item (d);

e) The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline.

22.2.4 Rates and Wages and Conditions of Labour

Add the following as sub-paragraph (c).

(c) The Contractor shall provide equal wages and benefits regardless of gender, ethnicity or caste, for work of equal value or type.

22.2.5 Working Hours

(a) Normal working hours shall be 0730hrs to 1700hrs Monday to Saturday

22.2.7 Health and Safety

(d) The Contractor shall throughout the contract (including the Defect Liability Period):

(i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Employer's and Project Manager's employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular;

(ii) provide male or female condoms for all Site staff and labor as appropriate; and

(iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Facilities under Subclause 18.2 an alleviation program for Site staff and labor and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Subclause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for the preparation and implementation this program shall not exceed the amount dedicated for this purpose.

22.2.8 Funeral Arrangements

Funeral arrangements cost shall be borne by the contractor

22.2.16 Prohibition of Harmful Child Labour

The provision in sub clause 22.2.16 of section 7: General Conditions of Contract is replaced as follows:

The Contractor shall not employ any child to perform any work, including 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.

"Child" means a child below the statuary minimum age under the laws of Sri Lanka.

25. Commissioning and Operational Acceptance

25.2.2 The Guarantee Test of the Facilities of each Plant shall be successfully completed within twenty one (21) days from the date of Completion of the Facilities of the Plant.

26. Completion Time Guarantee

26.2 Applicable rate for liquidated damages: One half of one percent (0.5% of the Contract Price) per week.

Maximum deduction for liquidated damages: 10 % of the Contract Price.

26.3 No bonus will be given for earlier Completion of the facilities or part thereof.

27. Defect Liability

27.10 The critical components covered under the extended defect liability are PV inverters, battery inverters, wind generators, wind inverters, diesel generators, and batteries. The extended defect liability period shall be one year effective from the date of completion and handing over of the Project or any part thereof.

30. Limitation of Liability

30.1 (b) The multiplier of the Contract Price is 1.1

34. Insurance

34.3 Add the following text at the end of the paragraph.

"period for submission of insurance

(a) certificates of insurance -Not later than Commencement Date,

(b) copies of the insurance policies -Not later than Commencement Date "

35. Unforeseen Conditions

The following is added at the end of Sub-Clause 35.3 of Section 7 : General Conditions of Contract:

"In addition to notice of any unforeseeable physical conditions, the Contractor shall provide the Engineer with a written notice of any unanticipated environmental or resettlement risks or impacts that arise during construction, implementation or operation of the Plant or Permanent Works.

45. Disputes and Arbitration

45.1 The Dispute Board shall be appointed within 28 days after the Effective Date.

The Dispute Board shall be of a Dispute Board of Three (3) members

List of potential Dispute Board members is Nill.

45.2 Appointment (if not agreed) to be made by: the President of the Institute of Engineers of Sri Lanka.

45.5 Rules of procedure for arbitration proceedings:

(a) Contracts with foreign contractors:

International arbitration shall be conducted in accordance with the UNCITRAL Arbitration Rules

Arbitration shall be administered by The Institution of Engineers Sri Lanka.

The place of arbitration shall be Sri Lanka.

(b) Contracts with contractors being nationals of the Employer's country: any dispute between the Employer and a Contract who is a national of the Employer's country arising in connection with the present Contract shall be referred to arbitration in accordance with the Arbitration Act No. 11 of 1995 of Sri Lanka (as amended).

46. Eligibility

46.1 The Contractor shall have the Indian nationality. The Contractor shall be deemed to have the Indian nationality if the Contractor is a citizen or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of India. This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.

46.2 The materials, equipment and services to be supplied under the Contract shall have their origin in eligible source countries and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, the Contractor may be required to provide evidence of the origin of materials, equipment and services.

46.3 For purposes of SCC 46.2, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

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Notification of Award

[*Employer's letterhead*]

Letter of Acceptance

[*date*]

To: [*Name and address of the contractor*]

This is to notify you that your Bid dated [*date*] for execution of the [*name of the contract and identification number, as given in the Bid Data Sheet*] for the Contract Price in the aggregate of [*amounts in words and figures*] [*name of currency*], as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose one of the Performance Security Forms included in Section 9 (Contract Forms) of the Bidding Document.

Authorized Signature:

Name and Title of Signatory:

Name of Agency:

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made on the [*insert number*] day of [*insert month*], [*insert year*],

BETWEEN

(1) [*name of the employer*], a corporation incorporated under the laws of [*country of the employer*] and having its principal place of business at [*address of the employer*] (hereinafter called "the Employer"), and (2) [*name of the contractor*], a corporation incorporated under the laws of [*country of the contractor*] and having its principal place of business at [*address of the contractor*] (hereinafter called "the Contractor").

WHEREAS the Employer desires to engage the Contractor to design, manufacture, test, deliver, install, complete and commission certain Facilities, viz. [*list of facilities*] ("the Facilities") and the Contractor have agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1 Contract Documents

1.1 **Contract Documents** (Reference GCC Clause 2)
The following documents shall constitute the Contract between the Employer and the Contractor, and each shall be read and construed as an integral part of the Contract:

(a) This Contract Agreement and the Appendixes hereto
(b) Letter of Bid and Price Schedules submitted by the Contractor
(c) Special Conditions of Contract
(d) List of Eligible Countries that was specified in Section 5 of the Bidding Document
(e) General Conditions of Contract
(f) Specifications
(g) Drawings
(h) Other completed Bidding Forms submitted with the Letter of Bid
(i) Any other documents forming part of the Employer's Requirements
(j) Any other documents shall be added here[1]

1.2 **Order of Precedence** (Reference GCC Clause 2)
In the event of any ambiguity or conflict between the Contract Documents listed above, the order of precedence shall be the order in which the Contract Documents are listed in Article 1.1 (Contract Documents) above.

1.3 **Definitions** (Reference GCC Clause 1)
Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions.

[1] Tables of Adjustment Data may be added if the contract provides for price adjustment (see GCC 11).

Article 2
Contract Price and Terms of Payment

2.1 **Contract Price** (Reference GCC Clause 11)
The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of [. . . *amounts of foreign currency in words* . . .], [. . . *amounts in figures*. . .] as specified in Price Schedule No. 5 (Grand Summary), [. . . *amounts of local currency in words* . . .], [. . . *amounts in figures*. . .], or such other sums as may be determined in accordance with the terms and conditions of the Contract.

2.2 **Terms of Payment** (Reference GCC Clause 12)
The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in the Appendix (Terms and Procedures of Payment) hereto.

The Employer shall instruct its bank to issue an irrevocable confirmed documentary credit made available to the Contractor in a bank in the country of the Contractor. The credit shall be for an amount of [. . . *amount equal to the total named in Schedule 1 less the advance payment to be made for plant and mandatory spare parts supplied from abroad*. . .]; and shall be subject to the Uniform Customs and Practice for Documentary Credits 1993 Revision, ICC Publication No. 500.[2]

In the event that the amount payable under Schedule No. 1 is adjusted in accordance with GCC 11.2 or with any of the other terms of the Contract, the Employer shall arrange for the documentary credit to be amended accordingly

Article 3
Effective Date

3.1 **Effective Date** (Reference GCC Clause 1)
The Effective Date upon which the period until the Time for Completion of the Facilities shall be counted from is the date when all of the following conditions have been fulfilled:

(a) This Contract Agreement has been duly executed for and on behalf of the Employer and the Contractor.

(b) The Contractor has submitted to the Employer the performance security and the advance payment guarantee.

(c) The Employer has paid the Contractor the advance payment.

(d) The Contractor has been advised that the documentary credit referred to in Article 2.2 above has been issued in its favor.

Each party shall use its best efforts to fulfill the above conditions for which it is responsible as soon as practicable.

3.2 If the conditions listed under 3.1 are not fulfilled within 2 months from the date of this Contract notification because of reasons not attributable to the Contractor, the parties shall discuss and agree on an equitable adjustment to the Contract Price and the Time for Completion and/or other relevant conditions of the Contract.

[2] Or Uniform Customs and Practice for Documentary Credits 2007 Revision, ICC Publication No. 600 (or the latest version).

Article 4 Communications

4.1 The address of the Employer for notice purposes, pursuant to GCC 4.1 is: [*Employer's address*].

4.2 The address of the Contractor for notice purposes, pursuant to GCC 4.1 is: [*Contractor's address*].

Article 5. Appendixes

5.1 The Appendixes listed in the attached List of Appendixes shall be deemed to form an integral part of this Contract Agreement.

5.2 Reference in the Contract to any Appendix shall mean the Appendixes attached hereto, and the Contract shall be read and construed accordingly.

IN WITNESS WHEREOF the Employer and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Signed by, for and on behalf of the Employer

[*Signature*]

[*Title*]

in the presence of

[*Signature*]

[*Title*]

Signed by, for and on behalf of the Contractor

[*Signature*]
[*Title*]

in the presence of

[*Signature*]
[*Title*]

APPENDIXES

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 Employer
Appendix 7 - List of Documents for Approval or Review
Appendix 8 - Functional Guarantees

Appendix 1 - Terms and Procedures of Payment

In accordance with the provisions of GCC Clause 12 (Terms of Payment), the Employer shall pay the Contractor in the following manner and at the following times, based on the Price Breakdown given in the section on Price Schedules. Payments will be made according to the breakdown of Contract Price for the Facilities of each Plant and in the currencies quoted by the Bidder unless otherwise agreed between the parties. Applications for payment in respect of part deliveries may be made by the Contractor as work proceeds.

(A) Terms of Payment

Schedule No. 1 - Plant and Mandatory Spare Parts Supplied from Abroad

The CIP amount referred to in Schedule No.1 is the CIP amount for the Facilities of a Plant.

In respect of plant and mandatory spare parts supplied from abroad, the following payments shall be made upon the completion.

Ten percent (10%) of the total CIP amount as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the plant and mandatory spare parts delivered to the site, as evidenced by delivery documents.

Eighty percent (80%) of the total or pro rata CIP amount upon Incoterm “CIP,” upon delivery to the site within 10 days after receipt of invoice.

Five percent (5%) of the total or pro rata CIP amount upon issue of the Completion Certificate, within 10 days after receipt of invoice.

Five percent (5%) of the total or pro rata CIP amount upon issue of the Operational Acceptance Certificate, within 10 days after receipt of invoice.

Schedule No. 2 - Plant and Mandatory Spare Parts Supplied from Within the Employer’s Country

The EXW amount referred to in Schedule No.2 is the EXW amount for the Facilities of a Plant.

In respect of plant and mandatory spare parts supplied from within the Employer’s country, the following payments shall be made:

Ten percent (10%) of the total EXW amount as an advance payment against receipt of invoice, and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the plant and mandatory spare parts delivered to the site, as evidenced by delivery documents.

Eighty percent (80%) of the total or pro rata EXW amount upon Incoterm “Ex-Works,” upon delivery to the site within 10 days after receipt of invoice.

Five percent (5%) of the total or pro rata EXW amount upon issue of the Completion Certificate, within 10 days after receipt of invoice.

Five percent (5%) of the total or pro rata EXW amount upon issue of the Operational Acceptance Certificate, within 10 days after receipt of invoice.

Schedule No. 3 - Design Services

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

Ten percent (10%) of the total design services amount as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer.

Eighty percent (80%) of the total or pro rata design services amount upon acceptance of design by the Project Manager within ten (10) days after receipt of invoice.

Five percent (5%) of the total or pro rata value of design services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon issue of the Completion Certificate, within ten (10) days after receipt of invoice.

Five percent (5%) of the total or pro rata value of design services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon issue of the Operational Acceptance Certificate, within ten (10) days after receipt of invoice.

Schedule No. 4 - Installation and Other Services

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

Ten percent (10%) of the total installation and other services amount as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of work performed by the Contractor as evidenced by the invoices for installation services.

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 Employer's authorization of the Contractor's application, will be made monthly within 10 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 Employer's authorization of the Contractor's monthly applications, upon issue of the Completion Certificate, within 10 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 Employer's authorization of the Contractor's monthly applications, upon issue of the Operational Acceptance Certificate, within 10 days after receipt of invoice.

In the event that the Employer fails to make any payment on its respective due date, the Employer shall pay to the Contractor interest on the amount of such delayed payment at the rate of 1.05 times the discount rate of the central bank in the country of currency of payment, and shall be paid in such currency for period of delay until payment has been made in full.

(B) Payment Procedures

When applying for certification and making payments, the procedures shall be as follows:

B1. Advance Payment

The Project Manager shall issue an Interim Payment Certificate for the advance payment, after the Contractor has delivered, to the Employer, the performance security, (as per sub-clause 13.3) and advance payment security (as per sub-clause 13.2) and Contractor's application for advance payment (invoice) in amounts and currencies equal to the advance payments.

The advance payments shall be repaid through percentage deductions in Interim Payment Certificates certified by the Project Manager in accordance with the procedure stated below.

(a) deductions shall commence from the first Interim Payment Certificate; (excluding the advance payments, deductions and repayments of retention) and
(b) deductions shall be made at the amortization rate of ten percent (10%) of the amount of all Interim Payment Certificates (excluding the advance payments, deductions and repayments of retention) in the types and proportionate amounts of currencies of the advance payments, until such time as the advance payments have been repaid.

If the advance payments have not been repaid prior to the issue of the Completion Certificate for the Works or prior to termination, the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

Payment of foreign currency portion of advance payment within ten (10) days of Interim Payment Certificate issued for the advance payment by transferring the amount due into a bank account, nominated by the Contractor, in a country named by the Contractor. Payment of local currency portion of advance payment within ten (10) days of Interim Payment Certificate issued for the same by a cheque from a local bank drawn in favour of the Contractor.

B2. Payment of Foreign Currency Portion

The Employer shall instruct its bank to issue an irrevocable Letter of Credit made available to the Contractor in a bank in country of the Contractor. If the Contractor requires the confirmation this Letter of Credit the cost of this shall be borne by the Contractor. The value of this Letter of Credit shall be the **foreign currency portion** of ninety percent (90%) of the total CIP value of Plant and Equipment supplied from abroad.

The Employer shall pay **foreign currency portion** of any other payments due to the Contractor from the Employer within ten (10) days of Interim Payment Certificate issued for the same by Transferring the amount due into a bank account, nominated by the Contractor, in a country named by the Contractor.

B3. Payment of Local Currency Portion

The Employer shall pay **local currency portion** of all payments due to the Contractor from the Employer within ten (10) days of Interim Payment Certificate issued for the same as a direct payment from Government of India or by a cheque from a local bank drawn in favour of the Contractor.

B4. Payment for Plant and Equipment supplied from abroad upon shipment

The Project Manager shall issue an Interim Payment Certificate for eighty percent (80%) of the total CIP amount of the value of the plant and equipment shipped and delivered to the site after receipt of Contractor's application for payment (invoice) and original or certified faxed copies of Inspection certificate & Packing list.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total CIP amount of the value of the all plant and equipment supplied from abroad and shipped and delivered to site upon the issue of the Completion Certificate, after receipt of Contractor's application for payment (invoice) and copy of Completion Certificate.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total CIP amount of the value of the all plant and equipment supplied from abroad and shipped and delivered to site upon the issue of the Operational Acceptance Certificate, after receipt of Contractor's application for payment (invoice) and copy of Operational Acceptance Certificate.

Contractor shall claim the amount (foreign currency portion**)** certified in the Interim Payments certificate issued for plant and equipment shipped and delivered to site against Letter of Credit made available to the Contractor and established by the Employer. A faxed copy of the Interim Payment certificate together with the original shipping documents shall accompany the Contractors claim.

Shipping documents shall include the following,

(i) A clean shipped bill of lading or charter party bill of lading. (The first and the second originals among three sets originally signed shall be submitted.)
(ii) Contractor's application for payment (invoice) showing commodity description, quantity, unit price, total price and basis of delivery, reference to items as per Bill of Quantities, Schedule of Prices.
(iii) Policy or certificate of insurance.
(iv) Manufacturer's Guarantee.
(v) Inspection certificate.
(vi) Packing list and weight certificate
(vii) Other documents required by the formalities of the Loan Agreement, if any.

B5. Payment for Plant and Equipment supplied from within the Employer's Country

The Project Manager shall issue an Interim Payment Certificate for eighty percent (80%) of the total EXW amount of the value of the plant and equipment delivered to site after receipt of Contractor's application for payment (invoice) and evidence of delivery to site.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total EXW amount of the value of the all plant and equipment supplied from within the Employer's Country and delivered to site upon the issue of the Completion Certificate, after receipt of Contractor's application for payment (invoice) and copy of Completion Certificate.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total EXW amount of the value of the all plant and equipment supplied from within the Employer's Country and delivered to site upon the issue of the Operational Acceptance Certificate, after

receipt of Contractor's application for payment (invoice) and copy of Operational Acceptance Certificate.

The Employer shall pay the certified amount stated on the Interim Payment Certificate for the plant and equipment delivered to site within twenty eight (28) days of Interim Payment Certificate issued for the same as a direct payment from Government of India or by a cheque from a local bank drawn in favour of the Contractor.

Evidence of delivery to site shall include the following,

(i) A certificate of arrival at site issued by the Project Manager with respect to plant and equipment delivered to site.
(ii) Contractor's application for payment (invoice) showing commodity description, quantity, unit price, total price and basis of delivery, reference to items as per Bill of Quantities, Schedule of Prices.
(iii) Manufacturer's Guarantee.
(iv) Inspection certificate.
(v) Packing list and weight certificate
(vi) Other documents required by the formalities of the Loan Agreement, if any.

B6. Payment for Design Services

The Contractor shall apply for payment (invoice) for design services completed either in one or two instalments.

The Project Manager shall issue an Interim Payment Certificate for eighty percent (80%) of the total value of the design services completed after receipt of Contractor's application for payment (invoice) and a certificate issued by Project Manager certifying the completion of the design.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total certified value of the design services completed upon the issue of the Completion Certificate, after receipt of Contractor's application for payment (invoice) and copy of Completion Certificate.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total certified value of the design services completed upon the issue of the Operational Acceptance Certificate, after receipt of Contractor's application for payment (invoice) and copy of Operational Acceptance Certificate.

The Employer shall pay foreign currency portion of the amount certified in the Interim Payments certificate issued for design services completed within twenty eight (28) days of Interim Payment Certificate issued for the same by transferring the amount due into a bank account, nominated by the Contractor, in a country named by the Contractor.

The Employer shall pay local currency portion of the amount certified in the Interim Payments certificate issued for design services completed within twenty eight (28) days of Interim Payment Certificate issued for the same as a direct payment from Government of India or by a cheque from a local bank drawn in favour of the Contractor.

B7. Payment for Installation and other Services

Payments will be made on actual quantities on measure and pay basis.

The Contractor shall submit a statement three copies to the Project Manager after the end of each month, in a form approved by the Project Manager, showing the amounts to which the Contractor considers himself to be entitled, payment for Installation and other Services, together with supporting documents which shall include the detailed report on the progress during the

month in a form approved by the Project Manager. The statement shall include the following items,

(a) the contract value and the Installation and other Services executed up to the end of the month,
(b) any amounts to be added and deducted for changes in legislation
(c) any amounts to be deducted for retention, calculated by applying the ten percent (10%) to the total of the above amount, until the amount so retained by the Employer reaches the limit of total retention equal to ten percent (10%) of the total contract value for Installation and other services
(d) any amount to be deducted for the advance payment,
(e) the deduction of the amounts certified for Installation and other Services, in all previous Interim Payment Certificates.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total certified value of the Installation and other Services completed upon the issue of the Completion Certificate, after receipt of Contractor's application for payment (invoice) and copy of Completion Certificate.

The Project Manager shall issue an Interim Payment Certificate for five percent (05%) of the total certified value of the Installation and other Services completed upon the issue of the Operational Acceptance Certificate, after receipt of Contractor's application for payment (invoice) and copy of Operational Acceptance Certificate.

The Employer shall pay foreign currency portion of the amount certified in the Interim Payments certificate issued for installation and other services completed within twenty eight (28) days of Interim Payment Certificate issued for the same by transferring the amount due into a bank account, nominated by the Contractor, in a country named by the Contractor.

The Employer shall pay local currency portion of the amount certified in the Interim Payments certificate issued for Installation and other Services within twenty eight (28) days of Interim Payment Certificate issued for the same as a direct payment from Government of India or by a cheque from a local bank drawn in favour of the Contractor.

B8. Final Statement

Not later than 56 days after successful completion of Defects Liability period, the Contractor shall submit to the Project Manager three copies of a draft final statement with supporting documents showing in detail, in a form approved by the Project Manager:

(a) The value of all work done in accordance with the Contract, and
(b) Any further sums which the Contractor considers to be due to him under the Contract or otherwise.

If the Project Manager disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Project Manager may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Project Manager the final statement as agreed.

If following discussions between the Project Manager and the Contractor and any changes to the draft final statement which may be agreed between them, it becomes evident that a dispute exists, the Project Manager shall issue an Interim Payment Certificate for those parts of the draft final statement which are not in dispute. The dispute may then be resolved under clause 45, in which case the Contractor shall then prepare and submit to the Employer a Final Statement in accordance with the outcome of the dispute.

The Employer shall not be liable to the Contractor for any matter or thing arising out of (or in connection with) the Contract or execution of the Works, unless the Contractor shall have included a claim for it in his Final Statement.

When submitting the Final Statement, the Contractor shall submit a written discharge which confirms that the total of the Final Statement represents full and final settlement of all monies due to the Contractor under the Contract. Such discharge may state that it shall become effective only after payment due under the Final Payment Certificate has been made and the performance security has been returned to the Contractor.

B9. Final Payment Certificate

The Project Manager shall issue the Final Payment Certificate within 28 days after receiving the Final Statement and written discharge as stated above stating the following,

(a) the amount which is finally due, and
(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance, if any due from the Employer to the Contractor or from Contractor to the Employer as the case may be.

If the Contractor has not submitted the Final Statement and the written discharge, the Project Manager shall request the Contractor to do so. If the Contractor fails to submit the same within a period of 28 days, the Project Manager shall issue the Final Payment Certificate for such amount as he considers to be due.

The Employer shall pay foreign currency portion of the amount certified in the Final Payments certificate within twenty eight (28) days of Final Payment Certificate by transferring the amount due into a bank account, nominated by the Contractor, in a country named by the Contractor.

Appendix 2 - Price Adjustment

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:

$$P_1 = P_0 x \left(a + b \frac{L_1}{L_0} + c \frac{M_1}{M_0} + d \frac{N_1}{N_0} \right) - P_0$$

in which:

P_1 = adjustment amount payable to the Contractor

P_0 = Contract price (base price)

a = percentage of fixed element in Contract price (*a* = %)

b = percentage of labor component in Contract price (*b* = %)

c = percentage of material and equipment component in Contract price (*c* = %)

d = percentage of material and equipment component in Contract price (*d* = %)

L_0, L_1 = labor indexes applicable to the appropriate industry in the country of origin on the base date and the date for adjustment, respectively

M_0, M_1= material and equipment indexes in the country of origin on the base date and the date for adjustment, respectively

N_0, N_1= material and equipment indexes in the country of origin on the base date and the date for adjustment, respectively

Conditions Applicable to Price Adjustment

The Bidder shall indicate the source of labor and materials indices and the base date indices in its bid.

Concrete Works (**Indices published in bulletin of Construction Statistics by ICTAD Sri Lanka shall be used)**	a= 0.5 (50%)	Fixed component	-
	b_1=0.05 (5%)	Skilled labor	
	b_2 = 0.07(7%)	Unskilled labor	
	c_1=0.24(24%)	M3 - Cement Local market price for cement	
	c_2=0.14(14%)	M13 - Reinforced Steel	

The base date shall be the date 28 days prior to the deadline for submission of the Bid.

The date of adjustment shall be the mid-point of the period of manufacture or installation of the 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 Employer under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Employer will, however, be entitled to any price decrease occurring during such periods of delay.

(b) If the currency in which the Contract price, P_0, is expressed is different from the currency of the country of origin of the labor and/or materials indexes, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall correspond to the ratio of exchange rates between the two currencies on the base date and the date for adjustment as defined above.

(c) No price adjustment shall be payable on the portion of the Contract price paid to the Contractor as an advance payment.

(d) For concrete works, the Source of Indices shall be the published in the Institute for Construction Training and Development (ICTAD) Sri Lanka, Bulletin of Construction Statistics. Price Escalation shall not be applied for foreign currency component of concrete works and be applied only for local currency component

(e) Price adjustment is applicable only to the items listed in the Tables of Adjustment Data, Section 4.

Appendix 3 - Insurance Requirements

(A) Types of Insurance to Be Taken Out by the Contractor

In accordance with the provisions of GCC Clause 34, 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 types of insurance 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 Employer, such approval not to be unreasonably withheld.

(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]
Full value of shipment	Nil	Employer Contractor	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]
Contract value	LKR100,000	Employer Contractor Sub-Contractors	Site	Site

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities that have been accepted by the Employer) 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]
Contract value	LKR100,000	Employer Contractor Sub-Contractors	Site	Site

(d) Automobile Liability Insurance
Covering use of all vehicles used by the Contractor or its Subcontractors (whether owned by them or not) 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) Employer's Liability
In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(g) Other Insurance
The Contractor is also required to take out and maintain at its own cost the following types of insurance:

Details:

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

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Subclause 34.1, except for the Third Party Liability, Workers' Compensation, and Employer's Liability Insurance, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Subclause 34.1, except for the Cargo, Workers' Compensation and Employer's Liability Insurance. 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.

(B) Types of Insurance to Be Taken Out by the Employer

The Employer shall at its expense take out and maintain in effect during the performance of the Contract the following insurance policies.

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
None				

Appendix 4 - Time Schedule

The contractor should submit the time schedule of the work programs at the time of contract award.

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

A list of major items of plant and services is provided below.

The following Subcontractors and Manufacturers are approved for carrying out the item of the facilities indicated. Where more than one Subcontractor is listed, the Contractor is free to choose between them, but it must notify the Employer of its choice in good time prior to appointing any selected Subcontractor. In accordance with GCC Subclause 19.1, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontracts shall be placed with any such Subcontractors for additional items until the Subcontractors have been approved in writing by the Employer and their names have been added to this list of Approved Subcontractors.

Major Items of Plant and Services	Approved Subcontractors and Manufacturers	Nationality

Appendix 6 - Scope of Works and Supply by the Employer

None of the facilities, works, and supplies will be provided or supplied by the Employer.

Appendix 7 - List of Documents for Approval or Review

Pursuant to GCC Subclause 20.3.1, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of GCC Subclause 18.2 (Program of Performance), the following documents for

(A) Approval

1. Construction drawings

2. Test reports, standards certificates, quality control reports etc.

3. Design reports

4. Method statements

5. Any other documents specified in the specification or as request by the Engineer

(B) Review

1. As built drawings

2. Operation and maintenance manuals

3. Any other documents specified in the specification or as request by the Engineer

Appendix 8 - Functional Guarantees

1. General

This Appendix sets out

(a) the functional guarantees referred to in GCC Clause 28 (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 calculating 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:

3. Functional Guarantees

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

3.1 Production Capacity

3.2 Raw Materials and Utilities Consumption

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 Subclause 25.2, 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 Employer in lieu of making changes, modifications and/or additions to the Facilities, pursuant to GCC Subclause 28.3, then the Contractor shall pay liquidated damages at the rate of 0.5% per week for every complete 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 1%.

4.2 Raw Materials and Utilities Consumption in Excess of Guaranteed Level

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 Subclause 25.2, is not more than the maximum level specified in para. 4.3 below, and the Contractor elects to pay liquidated damages to the Employer in lieu of making changes, modifications and/or additions to the Facilities pursuant to GCC Subclause 28.3, then the Contractor shall pay liquidated damages at the rate of 0.5% per week for every complete 1% of the excess consumption of the Facilities, or part thereof, of less than a complete 1%.

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 Subclause 28.2:

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

and/or

(b) average total cost of consumption of all the raw materials and utilities of the Facilities: 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 ten percent (10 %) of the Contract price

Performance Security

..... *Bank's name, and address of issuing branch or office*[1] .....

Beneficiary: .....*Name and address of the employer* .....

Date:.....

Performance Guarantee No.: .....

We have been informed that . . . . . *name of the contractor*.....(hereinafter called "the Contractor") has entered into Contract No. . . . . *reference number of the contract*. . . . . dated ..... with you, for the execution of . . . . . *name of contract and brief description of plant and services*.....(hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we . . . . . *name of the bank*.....hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of.....*name of the currency and amount in words*[2]. . . . . (. . . . . *amount in figures*. . . . .) such sum being payable in the types and proportions of currencies in which the Contract Price is payable, 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(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire no later than the earlier of

(a) 18 months after our receipt of

(i) a copy of the Completion Certificate; or
(ii) a registered letter from the Contractor, attaching a copy of the notice to the project manager that the Facilities are ready for commissioning, and stating that 14 days have elapsed from receipt of such notice (or 7 days have elapsed if the notice was a repeated notice) and the project manager has failed to issue a Completion Certificate or inform the Contractor in writing of any defects or deficiencies; or
(iii) a registered letter from the Contractor stating that no Completion Certificate has been issued but the Employer is making use of the Facilities; or

(b) the ____ day of _____, 2___.

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

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458 (*or ICC Publication No. 758 as applicable*), except that subparagraph (ii) of Sub-Article 20(a) is hereby excluded.[3]

. . . . . .

Signature(s) and seal of bank (where appropriate)

-- Note to Bidder --

If the institution issuing the performance security is located outside the country of the employer, it shall have a correspondent financial institution located in the country of the employer to make it enforceable.

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1 All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

2 The guarantor shall insert an amount representing the percentage of the contract price specified in the contract and denominated either in the currency(ies) of the contract or a freely convertible currency acceptable to the employer.

3 Or the same or similar to this clause specified in the Uniform Rules for Demand Guarantees, ICC Publication No. 758, where applicable.

Advance Payment Security

..... *Bank's name, and address of issuing branch or office*[1] .....

Beneficiary: ..... *Name and address of the employer* .....

Date: .....

Advance Payment Guarantee No.: .....

We have been informed that . . . . . *name of the contractor*..... (hereinafter called "the Contractor") has entered into Contract No. . . . . *reference number of the contract*. . . . . dated.....with you, for the execution of . . . . . *name of contract and brief description of plant and services*.....(hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum . . . . . *name of the currency and amount in words*[2]. . . . . (. . . . . *amount in figures*.....) is to be made against an advance payment guarantee.

At the request of the Contractor, we . . . . . *name of the bank*..... hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of.....*name of the currency and amount in words*[3]. . . . . (. . . . . *amount in figures*.....) 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 used the advance payment for purposes other than the costs of mobilization in respect of the Works.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number . . . . . *contractor's account number*. . . . . at . . . . . *name and address of the bank*. . . . . .

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates, which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate, indicating that 80% of the Contract Price has been certified for payment, or on the . . . day of . . . . . , ..., [4] whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458 (*or ICC Publication No. 758 as applicable*).

. . . . . .

Signature(s) and seal of bank (where appropriate)

-- Note to Bidder --

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1 All italicized text serves as a guide for preparing this demand guarantee and shall be deleted from the final document.

2 The guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the contract, or in a freely convertible currency acceptable to the employer.

3 Footnote 2.

4 Insert the expected expiration date of the time for completion. The employer should note that in the event of an extension of the time for completion of the contract, the employer would need to request an extension of this guarantee from the guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months][1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

If the institution issuing the advance payment security is located outside the country of the employer, it shall have a correspondent financial institution located in the country of the employer to make it enforceable.

Figure 1

AGREMENT FOR RE-SUPPLYING, INSTALLATION AND DISPOSAL OF Li-Ion/LFP BATTERIES

Tender No :
Supporting Electricity Supply Reliability Improvement Project-package 6
Construction of renewable energy systems in small islands

We, …… ……{company name}, having the office at ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,{address} , the suppliers of the Li ion battery banks for three hybrid systems constructed at Analthivu, Nainathivu and delft islands of Sri Lanka under Tender no: ……hereby guarantee that

Supply of new batteries required for future capacity additions or replacement

We shall provide batteries at the following FOB rate subject to price adjustment for future 20 years period for future capacity additions or replacement of battery banks in three hybrid systems constructed under above project in Analthivu, Nainathivu and delft islands.

The FOB rate (Base price) applicable for future procurement of 20 years period is given below.

Battery details	**Unit FOB price of a battery as given in price schedule of the bid**	**Currency type**
Li-ion battery model no: ……and manufactured in.....(company & address) having ……V (voltage) , ……kWh and ……kg in weight, ……(height x length x breadth) with same battery management system as supplied for above tender		

Price Adjustment Formula

Further to that I agree for calculating the exact price of future supplying battery banks by applying the price variation formula given below.

$$P_1 = P_0 \times (a + b_i \frac{L_{i1}}{L_{i0}} + c_i \frac{M_{i1}}{M_{i0}} + ...) - P_0$$

in which:

P0 = contract price (base price) of items for which price adjustments is applicable

P1 = adjustment amount payable to the Contractor for each items for which price adjustments is applicable

a = percentage of fixed element (a = %)

bi = percentages of labor components (bi = %)

ci = percentages of material and equipment components (ci = %)

Li0, Li1 = labor indexes applicable to the appropriate industry in the country of origin on the base date and the date for adjustment, respectively

Mi0, Mi1 = material and equipment indexes in the country of origin on the base date and the date for adjustment, respectively

Conditions Applicable to Price Adjustment

I shall indicate the source of labor and materials indices and provide the base date indices as following.

Item	Co-efficient	Source of Indices Used	Base Date Indices
Li ion battery as described above			

Further I agree to apply the price adjustment formula subject to the following conditions

The base date shall be the date 28 days prior to the deadline for submission of the Bid.

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

No price increase will be allowed beyond the original delivery date unless covered by an extension of time awarded by the Employer under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Employer will, however, be entitled to any price decrease occurring during such periods of delay.

If the currency in which the Contract price, P0, is expressed is different from the currency of the country of origin of the labor and/or materials indexes, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall correspond to the ratio of exchange rates between the two currencies on the base date and the date for adjustment as defined above.

Regarding, freight, insurance and local transportation charges of the future supplying battery banks shall be fixed on the prevailing market rates after getting concurrence of Client, at the time of order is placed for new batteries.

Cost of Installation of new batteries to be supplied under above (A)

We hereby agree for replacement and installation of new battery banks at a fixed rate given below that is valid for future 20 years period.

details	Total fixed price for the installation/replacement	Currency type
Installation of a set of Li-Ion/LFP battery module at hybrid power plants constructed under above tender in Analithivu, Delft or Nainathivu island		

Battery Disposal

In additional to that I agree to remove all batteries supplied by me for above contract at the end of their life span period from the project sites to outside of Sri Lanka taking the responsibility of dismantling, packaging and transporting all used battery cells , modules, entire battery racks or containerized packages at the time of replacement. The fixed charge valid for next 20 years period is as following.

details	Total fixed price for the battery dismantling and disposal	Currency type
Cost for dismantling, packaging and transporting a set of used battery module including cells, entire battery racks or containerized packages back to the supplier or a battery recycling company outside of Sri Lanka from any one hybrid system constructed under above project		

Further, I understand that Government of Sri Lanka prohibits the disposal in landfills or by incineration of waste batteries and accumulators.

Transport of Li-Ion/LFP Li-Ion/LFP Batteries

I certify that I transport Li ion batteries complying with rules “UN dangerous good transport recommendations”, model regulation ST/SG/AC10/Rev.16; UN 3480 category of dangerous goods: Class 9

For and on behalf of the.....,

Common seal of the..... is affixed in the presence of ;

Company Seal	Signature/Name/Designation	Signature/Name/Designation

WITNESSES :-`

Name/NIC Number	Signature	Address
1 . ……	……	……
2 . ……	……	……