Central Electricity Board

BIDDING DOCUMENTS

for

Design, Supply, Installation, Testing and Commissioning of 1MWac Solar PV Farm at Grenade, Rodrigues of the Republic of Mauritius

(Single Stage – Single Envelope)

Procurement Reference No: OAB-PROD-4324

Issued on: 30 October 2019

Open International Bidding

Notice to Bidders

Government e-Procurement System

In line with Government's plan towards a fully-fledged digital society requiring increased use of ICT in public administration, public bodies would, by the end of July 2019, carry out public procurement electronically on the Government e-Procurement System (e-PS). Consequently, the paper based procurement process would gradually be phased out.

The e-PS is live and a growing number of public bodies are already carrying out their procurement proceedings online.

In this respect, Bidders are advised to register at the earliest on the e-PS at the following address:
https://eproc.publicprocurement.govmu.org

A video for Bidders on "How to Register" can be viewed on YouTube at:
https://www.youtube.com/watch?v=MvH-PgQRS3k

All registered Bidders will automatically be alerted by email of all online Invitation for Bids issued by any public body.

For any further information, contact the Help Desk of Procurement Policy Office by the following email or phone number:
Email: eprocdesk@govmu.org
Tel: +230 201 1530

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1. Instructions to Bidders

A. General

1. Scope of Bid

1.1 The **CENTRAL ELECTRICITY BOARD** (hereinafter referred to as "the Employer"), wishes to receive bids for **Design, Supply, Installation, Testing and Commissioning of 1MWac Solar PV Farm at Grenade, Rodrigues, of the Republic of Mauritius** as defined in these bidding documents (hereinafter referred to as "the Works").

The Bidding Method is: **Open International Bidding**

Procurement Reference Number: **OAB/PROD/4324**

This Procurement shall be financed by the CEB

1.2 The successful bidder shall complete the Works and commission the PV Farm **within twelve (12) months from the Commencement Date.**

2. Public Entities Related to Bidding Documents & to challenge & appeal

2.1 The public entities related to these bidding documents are the Public Body, acting as procurement entity, the Procurement Policy Office, in charge of issuing standard bidding documents and responsible for any amendment these may require, and the Independent Review Panel, set up under section 45 of the Public Procurement Act 2006 (hereinafter referred to as the Act.)

2.2 Sections 43, 44 and 45 of the Act provide for challenge and review mechanism. Unsatisfied bidders shall follow procedures prescribed in Regulations 48, 49 and 50 of the Public Procurement Regulations 2008 to challenge procurement proceedings and award of procurement contracts or to file application for review at the Independent Review Panel.

(a) Challenges in respect of this procurement should be addressed to:

The Ag. General Manager
Central Electricity Board
Rue du Savoir,
Cybercity, EBENE.
Republic of Mauritius

Tel : +230-404-2000
Fax No : +230-454-7630/32
Email : ceb@intnet.mu

Application for Review should be filed at the IRP and addressed to:

The Chairman
Independent Review Panel
9th Floor, Wing B
Emmanuel Anquetil Building
Pope Hennessy Street
Port Louis
Tel No: (230) 2013921
Fax No: (230) 201 2423

3. Corrupt or Fraudulent Practices

3.1 It is the policy of the Government of the Republic of Mauritius to require Public Bodies, as well as bidders, suppliers, and contractors and their agents (whether declared or not), personnel, subcontractors, sub-consultants, service providers and suppliers, observe the highest standard of ethics during the procurement and execution of contracts. [1] In pursuance of this policy, the Government of the Republic of Mauritius:

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

(i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[2];

(ii) "fraudulent practice" is 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; [3]

(iii) "collusive practice" is an arrangement between two or more parties[4] designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice" is impairing or harming,

[1] In this context, any action taken by a bidder, supplier, contractor, or any of its personnel, agents, sub-consultants, sub-contractors, service providers, suppliers and/or their employees to influence the procurement process or contract execution for undue advantage is improper.

[2] "Another party" refers to a public official acting in relation to the procurement process or contract execution. In this context, "public official" includes Purchaser's staff and employees of other organizations taking or reviewing procurement decisions.

[3] "Party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

[4] "Parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, noncompetitive levels.

or threatening to impair or harm, directly or indirectly, any party[5] or the property of the party to influence improperly the actions of a party;

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede the Employer's investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or

(bb) acts intended to materially impede the exercise of the Employer's inspection and audit rights provided for under sub-clause 4.2 below.

(b) will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question; and

will sanction a firm or an individual, at any time, in accordance with prevailing legislations, including by publicly declaring such firm or individual ineligible, for a stated period of time: (i) to be awarded a public contract; and (ii) to be a nominated[b] sub-contractor, consultant, manufacturer or supplier, or service provider of an otherwise eligible firm being awarded a public contract.

3.2 Furthermore, bidders shall be aware of the provision under sub-clause 15.6 (f) of the Conditions of Contract, Part II.

3.3 In pursuance of this policy, Bidders shall permit the Employer to inspect any accounts and records and other documents

[5] "Party" refers to a participant in the procurement process or contract execution.

[b] A nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding document) is one which either has been: (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that are accounted for in the evaluation of the bidder's pre-qualification application or the bid; or (ii) appointed by the Purchaser.

relating to the Bid submission and contract performance, and to have them audited by auditors appointed by the Employer.

3.4 Bidders, suppliers and public officials shall also be aware of the provisions stated in sections 51 and 52 of the Public Procurement Act which can be consulted on the website of the Procurement Policy Office (PPO) : *ppo.govmu*.org

3.5 The Employer commits itself to take all measures necessary to prevent fraud and corruption and ensures that none of its staff, personally or through his/her close relatives or through a third party, will in connection with the bid for, or the execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to. If the Employer obtains information on the conduct of any of its employees which is a criminal offence under the relevant Anti-Corruption Laws of Mauritius or if there be a substantive suspicion in this regard, he will inform the relevant authority(ies)and in addition can initiate disciplinary actions. Furthermore, such bid shall be rejected.

4. Eligible Bidders

4.1 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country subject to Section 17 of the Act. A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. 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.

(a) With a view to facilitating participation by bidders, the public body shall accept the submission by bidders of equivalent documentation when particular documents required by the bidding documents are not available or issued, for example, in a foreign bidder's country of origin.

(b) Public bodies may also accept certifications from bidders attesting to compliance with eligibility requirements.

4.2 Public bodies may require the submission of signed statements from the bidders, certifying eligibility, in the absence of other documentary evidence establishing eligibility.

Eligibility requirements may concern:

(a) business registration, for which evidence may include the certificate of company registration;

(b) tax status, for which documentation of tax registration and

tax clearance are relevant;

(c) certifications by the bidder of the absence of a debarment order and absence of conflict of interest; and

(d) certification of status regarding conviction for any offence involving fraud, corruption or dishonesty.

4.3 A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest with one or more parties in this bidding process, if :

(a) they have a controlling partner in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

(e) a Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which the party is involved. However, this does not limit the inclusion of the same subcontractor in more than one bid; or

(f) a Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; or

(g) a Bidder, or any of its affiliates has been hired (or is proposed to be hired) by the Employer as Engineer for the contract.

4.4 (a) A firm that is under a declaration of ineligibility by the Government of Mauritius in accordance with applicable laws at the date of the deadline for bid submission and thereafter shall be disqualified.

(b) Bids from firms appearing on the ineligibility lists of African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank Group and World Bank Group shall be rejected.

Links for checking the ineligibility lists are available on the PPO's website: *ppo.govmu.org*

(c) Firms and individuals may be ineligible if they are nationals of ineligible countries. The countries, persons or entities are ineligible if:

(i) As a matter of law or official regulations, Mauritius prohibits commercial relations with that country; OR

(ii) By an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Mauritius prohibits any import of goods or contracting of works or services from that country, or any payments to any country, person, or entity in that country.

4.5 Government-owned enterprises in the Republic of Mauritius shall be eligible only if they can establish that they: (i) are legally and financially autonomous; (ii) operate under commercial law; and (iii) that they are not a dependent agency of the Government.

4.6 (1) While submitting any bid, a foreign individual, firm, company or institution, shall specify whether or not any agent has been appointed in Mauritius, and if so:

(a) the name and address of the agent;

(b) the figure of the commission amount payable to the agent, type of currency and mode of payment;

(c) any other condition agreed with the agent; and income tax registration certificate of the local agent and acceptance letter of the agent.

(2) If a bid submitted stated that there is no local agent, and if it is proved thereafter that there exists an agent or if a bid has stated an amount for a commission and it is proven that there exists a higher amount for that commission, action shall be taken against him for suspension and debarment in accordance with section 53 of the Act.

4.7 (1) In accordance with CIDB Act 2008, contractors currently operating in the CONSTRUCTION INDUSTRY have the statutory obligation to be registered with the Construction Industry Development Board (CIDB) accordingly.

(2) Subject to paragraph (5), foreign contractors as defined in the CIDB Act will have to apply for and obtain a Provisional Registration prior to bidding for any CONSTRUCTION project. If the contract is

awarded to a foreign contractor the latter shall have to apply for and obtain a Temporary Registration before starting the project.

(3) Contractors whether local or foreign under an existing or intended joint venture will be eligible as a joint venture if, in addition to their respective individual registration, they obtain a Provisional Registration for the joint venture prior to bidding for any CONSTRUCTION project. If an existing or intended joint venture is awarded the contract it shall have to apply for a Temporary Registration prior to starting the project.

(4) Sub-contractors, undertaking works or assignments in any CONSTRUCTION project are subject to registration as applicable to Contractors.

(5) Paragraph (2) shall not apply to Contractors who have been carrying out works during the last 20 years preceding 01 March 2017 in the CONSTRUCTION INDUSTRY; and where at least two thirds, or such other percentage as may be prescribed, of the total number of their employees are citizens of Mauritius.

(6) A foreign contractor referred to in paragraph (5) shall, for the purpose of registration, make an application with the CIDB and obtain a valid registration certificate prior to bidding for this project.

(7) Bidders are strongly advised to consult the website of the CIDB http://cidb.govmu.org for further details concerning registration of contractors/consultants.

4.8 Bidders shall provide such evidence of their continued eligibility satisfactory to the Public Body, as the Public Body shall reasonably request.

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries as defined in Sub-Clause 4.1 above and all expenditures made under the Contract will be limited to such materials, equipment, and services. At the Employer's request, bidders may be required to provide evidence of the origin of materials, equipment, and services.

5.2 For purposes of Sub-Clause 5.1 above, "services" means the works and all project-related services including design services.

5.3 For purposes of Sub-Clause 5.1 above, “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 is substantially different in basic characteristics or in purpose or utility from its components.

6. Qualification of the Bidder

6.1 To be qualified for award of Contract, bidders shall:

(a) submit written confirmation of authorization to sign on behalf of the Bidder demonstrating that the representative has been duly authorized to sign;

This authorization shall consist of written confirmation and shall be attached to the bid. It should either be a delegation of power by resolution of the Board of a company or from the CEO, himself holding power from the Board or through a Power of Attorney.

The name and position held by each person signing the authorization must be typed or printed below the signature.

In the case of Bids submitted by an existing or intended joint venture an undertaking signed by all parties

(i) stating that all parties shall be jointly and severally liable, and;

(ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the joint venture during the bidding process and, in the event the joint venture is awarded the Contract, during contract execution."

Note: The Power of Attorney or other written authorization to sign may be for a determined period or limited for a specific purpose.

(b) have adequate financial capacity and technical capability to undertake the Contract. This will include an assessment of bidder's proposals regarding work methods, scheduling and resourcing which shall be provided in sufficient detail to demonstrate the bidder's capability to complete the works in accordance with the Employer's Requirements and the time for completion. The Bidder shall also follow the request in Section 1 A – Evaluation and Qualification Criteria.

(c) be duly registered with the CIDB in Mechanical, Electrical and Plumbing (MEP) Works, and Building Construction Works under the Grade that would allow the bidder to perform the value of works for which it is submitting its bid The Areas of Specialization shall be: (i) B01 and (ii) E01.

(d) have to ascertain that sub-contractors, consultants or sub-consultants proposed for executing works or

assignments in the construction sector are duly registered with the CIDB in accordance with CIDB Act 2008 and pursuant to Section 6.2 (c) above.

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

(a) the bid, and in case of a successful bid, the Form of Contract Agreement, shall be signed so as to be legally binding on all partners;

(b) one of the partners shall be authorized to be in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners;

(c) the partner in charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture and the entire execution of the Contract;

(d) all partners of the joint venture shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms, and a relevant statement to this effect shall be included in the authorization mentioned under (b) above as well as in the Bid Form and the Form of Contract Agreement (in case of a successful bid); and

(e) a signed copy of the agreement entered into by the joint venture partners shall be submitted with the bid.

6.3 Bidders shall submit a technical offer in accordance to the Employer's requirements using the bid submission forms contained in Section V – Form of Bid and Appendices to the Bid. This shall include proposals of work methods and schedule in sufficient detail to demonstrate the adequacy of the bidder's proposals to meet the Employer's Requirements and the completion time referred to in Sub-Clause 1.2 above.

6.4 Bidders shall be appropriately assisted by the Original Equipment Manufacturers and submit the Manufacturer's Authorisation Form as per Form provided in the Sample Forms.

6.5 Bidders are required to comply with the Employer's Requirements and the other terms, conditions and provisions of the Bidding Documents.

7. One Bid per Bidder

7.1 Each bidder shall submit only one bid either by itself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid will cause all those bids to be rejected. However, this does not limit the inclusion of the same subcontractor in more than one Bid.

8. Cost of Bidding

8.1 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.

9. Site Visit

9.1 The bidder is advised to visit and examine the Site of Works 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 design-build and completion of the Works. The costs of visiting the Site shall be at the bidder's own expense.

The Employer will not entertain any claim based on the grounds of insufficient knowledge of the Site conditions.

9.2 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon 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.

9.3 The Employer may conduct a Site visit concurrently with the Pre-Bid Meeting referred to in Clause 21.

B. Bidding Documents

10. Content of Bidding Documents

10.1 The bidding documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause 12:

Volume 1

	Invitation for Bids
Section 1	Instructions to Bidders
1A	Evaluation and Qualification Criteria
2	Part I - General Conditions
3	Part II - Conditions of Particular Application
4	Employer's Requirements

Volume 2

Section 5	Form of Bid and Appendix to Bid
6	Sample Forms
7	Schedules
8	Drawings

10.2 The Bidder is expected to examine carefully the contents of the bidding documents. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Pursuant to Clause 30, bids which are not substantially responsive to the requirements of the bidding documents will be rejected.

11. Clarification of Bidding Documents

11.1 A prospective Bidder requiring any clarification of the bidding documents may notify the Employer in writing at the address indicated hereunder:

The Chairman Tender Committee
Central Electricity Board
Royal Road
Curepipe
Mauritius

E-mail address: ctc@ceb.intnet.mu

The Employer will respond to any request for clarification which it receives earlier than twenty one (21) days prior to the deadline for submission of Bids. Copies of the Employer's response, including a description of the inquiry, will be communicated to all the Bidders who have procured the Bidding document directly from the Employer. The response will not disclose the source of the inquiry.

All queries received within the deadline set and reply thereto will be available on the CEB's website: **https://ceb.mu** and/or the government procurement website http://publicprocurement.govmu.org.

The onus is on the bidders to check the websites at all times before the deadline for submission of the bids so as not to miss any communications.

12. Amendment of Bidding Documents

12.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bidding documents by issuing addenda.

12.2 Any addendum thus issued shall be part of the bidding documents pursuant to Sub-Clause 10.1, and shall be communicated in writing or by fax to all prospective bidders. Prospective bidders shall acknowledge receipt of each addendum by email to the Chairman Tender Committee (CTC).

12.3 To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may extend the deadline for submission of bids, in accordance with Clause 24.

C. Preparation of Bids

13. Language

13.1 The Bid as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in English. 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 in English, in which case, for purposes of interpretation of the Bid, such translation shall govern.

Notwithstanding the above, documents in French submitted with the bid may be accepted without translation.

14. Documents Comprising the Bid

14.1 The Bid submitted by the bidder shall comprise two envelopes submitted simultaneously, one containing only the technical proposal and the other the price proposal. Both envelopes shall then be sealed in a single envelope.

14.2 The Technical Proposal shall contain the following:

(i) Bid Form for Technical Proposal and Appendix to Technical proposal completed and signed by the Authorised Person of the Bidder (but not amended or added in any way);

(ii) Bid Security;

(iii) Written confirmation of authorization to sign on behalf of the Bidder demonstrating that the Representative has been duly authorized to sign;

(iv) Documentary evidence that the PV Plant and Equipment corresponds to the Employer`s Requirements) – a detailed description of the Plant and Equipment as well as essential technical and performance characteristics;

(v) Detailed description of the Scope of the Works, methodology, Programme of Works, including the Quality Control procedures, Factory testing procedures by the manufacturers and on Site test and commissioning procedures;

(vi) Layout of the PV System installation in 3D Format;

(vii) List of major items of Equipment, manufacturer's name and country of origin;

(viii) Proposed Civil structures;

(ix) Type Test Reports for Inverters, PV Modules , Step Up Transformers and MV switchgears;

(x) Pamphlets/Catalogues/Drawings of PV Modules, DC Connectors, Inverters, Combiner Box, LV Panels, , Medium Voltage Switchgears, Control Equipment, SCADA Screenshot, transformers, motorized low voltage circuit breakers, PLC, Air Conditioning system, fire alarm and firefighting systems among others;

(xi) All Documentation and Forms completed by the Bidder as requested in the Bidder's Qualification as per Section 1A: Evaluation and Qualification Criteria;

(xii) Joint Venture agreement, if the case is, for the constitution of a joint venture with the authorization to sign the Bid on behalf of the JV;

(xiii) Bidder's documentary evidence that:

- The Bidder is eligible to bid and the Subcontractors and Manufacturers for any

part of the Contract have or will have nationalities from eligible countries,

- The Bidder is qualified to perform the Contract if its Bid is accepted.

(xiv) Location and address of manufacturing facilities;

(xv) The time of manufacturing and past experience record pertaining for similar PV system supplied from the proposed manufacturer;

(xvi) Copy of duly filled Manufacturer's Authorization Forms, where applicable, in accordance, with the form in in the Sample Forms.;

(xvii) Organization Chart with the CVs of the Key Personnel to coordinate and supervise the Design, Supply, Installation, Testing and Commissioning of the PVPlant;

(xviii) Schedule of Major Items of Constructional Plant;

(xix) Schedule for Guaranteed Particulars of Specifications;

(xx) Schedule of Key Personnel;

(xxi) Schedule of Subcontractors;

(xxii) Schedule of Works Completion; and

(xxiii) any other materials or services required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

14.3 The Price proposal shall contain the following:

(i) Bid Form for Price Proposal and Appendix to Price Proposal;

(ii) Schedules of Prices

I. Design, Drawings and Documentation;
II. Plant and Equipment, including Mandatory Spare Parts supplied from outside the Employer's Country;
III. Plant and Equipment, including Mandatory Spare Parts supplied from within the Employer's Country;
IV. Civil Works, Installation and Other Service;
V. Summary
VI. Grand Summary;
VII. Training of CEB Personnel (OPTIONAL) and
VIII. Recommended Spare Parts including but not limited to spare parts from the Inverter Manufacturer;

(iii) Schedule of Payment;

14.4 All Schedules and Forms, duly completed by the Bidder, shall be signed and stamped by the Bidder, All pages of the

Bid shall be initialed by the Authorized Person. It is to be noted that no amendment is allowed to be made to original Schedules and Forms as this may lead to rejection of the Bid.

Bidders are particularly advised that the amount shown in in Price Proposal Form shall be for performing the Contract strictly in accordance with the Employer's Requirements and the Contract.

Plants Conformity:

The Bidder shall demonstrate the conformity of the PV Farm to the Employer's Requirements by submitting relevant documentary evidence.

The PV panels, inverters and any other equipment incorporated in the Works shall be only from such manufacturers who have extensive and recent experience in similar types of projects.

15. Bid Form and Price Schedules

15.1 The Bidder shall complete the Bid Form and the appropriate Price Schedules furnished in the bidding documents in the manner and detail indicated therein, following the requirements of Clauses 16 and 17;

16. Bid Prices

16.1 Unless specified otherwise in Employer's Requirements, Bidders shall quote for the entire facilities 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 documents in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the facilities. This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licenses, etc., operation maintenance and training services and such other items and services as may be specified in the bidding documents, all in accordance with the requirements of the Conditions of Contract and these bid documents.

Bids shall be quoted on a **DDP (Delivery Duty Paid)** basis to the **site of works** at Grenade, Rodrigues including local transport, unloading and insurance **but exclusive of VAT.**

VAT to be paid in Mauritius shall be borne by the CEB and where VAT has to be paid at point of entry to Mauritius, the Contractor shall present the required evidence of shipping documents which shall be inclusive of the Original Bill of Lading / Airway Bill, Original Invoices, Packing Lists and other documents, as appropriate to be mutually agreed between the Contractor and the Employer.

Where the Contractor must pay VAT to Subcontractors in Mauritius, the Contractor shall invoice the VAT to CEB, who shall reimburse the Contractor accordingly. This reimbursement of Value Added Tax shall not be considered as part of the Bid Price. The Contractor shall invoice this VAT to CEB using a locally VAT-registered number (VAT-Invoice).

The Contractor shall be responsible for the payment of Corporate Taxation in accordance with Mauritian laws.

Personal taxes such as Income Tax and any other direct individual taxes that may be required by Mauritian regulations are to be borne by the Contractor for all expatriate personnel.

Materials and equipment supplied from the local market shall be quoted inclusive of all duties and taxes (inclusive of all cost associated with labour etc.).

For more detailed information regarding duties and taxes, the Bidders shall obtain all information from MRA or shall refer to the following link:

http://www.mra.mu

The total lump-sum Bid Price shall include payments necessary to comply with all acts, laws, rules, work permits, pensions contributions, general local taxes, and all taxes and regulations prevailing at the time of Bidding including but not limited to those applicable in Mauritius (excluding VAT and Custom Duties as mentioned here above) and in the country of origin. These shall include but not be limited to the following Mauritian legislation:

- Health and Safety Act
- Building Regulations
- Labour Act
- Bank of Mauritius Act
- Income Tax Act (Employment of Foreign Nationals)
- Environment Protection Act.

This Contract shall not include a Contract Price Fluctuation Clause. The Bid Price shall be firm and fixed and no price variation shall be allowed for any rise or fall in cost of labor, materials, rates of currency exchange or any other factors affecting prices or the Works including inflation

Bids that are not fixed and firm in accordance with these requirements shall be considered as non-responsive and shall be rejected.
Bidders shall examine the Bidding documents carefully and make written request to the Employer for interpretation, clarifications or correction of any ambiguity, inconsistency or error therein, which he may discover upon examination of the Bidding documents, prior to the latest date for clarification as

defined in Clause 11 here above (the Base date) and they are without any restriction accepted by it.

No claim resulting from omissions or discrepancies in the Bidding documents, after the Base Date, will be accepted by the Employer.

The Bidder has to ensure that the information provided within the Bidding document is sufficient for him to quote for his final Total lump-sum Bid Price. No additional claim shall be entertained for supplies and services that are deemed to be included in the scope of Works.

In the event that the Bidder shall by his own error or negligence or misinterpretation fail to submit the correct prices, he shall nevertheless be bound by the Total lump-sum Bid Price quoted in the Price Proposal document and shall have no claim against the Employer for the payment of any additional amounts,

16.2 Bidders shall give a breakdown of the prices in the manner and detail called for in the Schedules of Prices. Bidders shall indicate the VAT component separately in the Bid Prices as the payment of VAT shall be borne by the CEB.

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

(a) Design including all necessary drawings and documentation for the Work.

(b) Plant and equipment to be supplied from outside the Employer's country (Schedules of Prices: II) including Mandatory Spare parts, shall be quoted on a DDP (delivered at site of work including unloading and insurance) basis.

DDP (delivered at site of work, including unloading and insurance) shall be at the respective site.

(c) Plant and equipment manufactured or fabricated within the Employer's country (Schedules of Prices: III) shall be quoted on a delivery on site basis and shall be inclusive of all costs as well as duties and taxes paid or payable on components and raw materials incorporated or to be incorporated in the facilities.

(d) Civil Works, Installation and Other Services shall be quoted separately (Schedules of Prices: IV) and shall include rates or prices for all labour, contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, including local transportation, operations and maintenance services, the provision of operations and maintenance manuals, training,

etc. in line with the scope of requirement of the bidding documents, as necessary for the proper execution of the Civil Works, Installation and Other Services.

(e) Mandatory and Recommended spare parts shall be quoted separately (Schedules of Prices: VI) as specified in either subparagraph (b) or (c) above in accordance with the origin of the spare parts.

16.4 The terms EXW, CIF, and DDP where applicable shall be governed by the rules prescribed in the current edition of Incoterms 2010, published by the International Chamber of Commerce, Paris.

16.5 Not Applicable

17. Bid Currencies

17.1 Prices shall be quoted in the following currencies:

(a) the prices shall be in any of the following currencies: EUR, USD, GBP and/or MUR;

(b) a bidder expecting to incur a portion of its expenditures in the performance of the Contract in more than one currency, and wishing to be paid accordingly, shall so indicate in its Bid; and

(c) if some of the contract expenditures related to Civil Works, Installation and Other Services pursuant to Clause 16.3(d) are to be incurred in Mauritius, such expenditures shall be quoted in MUR only.

17.2 Bidders shall indicate their expected foreign currency requirements in the Appendix to Price Proposal.

17.3 Bidders may be required by the Employer to clarify their local and foreign currency requirements, and to substantiate that the amounts included in the Schedule of Prices and shown in the Appendix to Bid are reasonable and responsive to Sub-Clause 16.1 in which case a detailed breakdown of its foreign currency requirements shall be provided by the bidder.

17.4 Not Applicable

18. Bid Validity

18.1 Bids shall remain valid for a period of 120 days as from the closing date for submission of bids specified in Sub-Clause 24.1 or up to **08 April 2020**, whichever is the latest.

18.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing or by fax. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be required or permitted to modify its bid, but will be

required to extend the validity of its bid security for the period of the extension, and in compliance with Clause 19 in all respects.

19. Bid Security

19.1 The Bidder shall furnish, as part of its bid, a bid security in the amount of **MUR 600,000**. The Bid Security shall be valid for a period of 150 days as from the bid submission deadline or up to **08 May 2020**, whichever is the latest.

19.2 The Bid Security shall be issued by a commercial bank operating in Mauritius. The format of the bank guarantee shall be in accordance with the sample form of bid security included in Section 6. The bid security shall remain valid for 30 days beyond the original validity period for the bid, and beyond any period of extension subsequently requested under Sub-Clause 18.2.

19.3 Any bid not accompanied by a bid security shall be rejected.

19.4 The bid securities of unsuccessful bidders will be returned as promptly as possible.

19.5 The bid security of the successful bidder will be returned when the bidder has signed the Contract Agreement and furnished the required Performance Security.

19.6 The bid security may be forfeited

(a) if the bidder withdraws its bid or increase his bid price and/or change the conditions of his bid after the deadline for submission of Bids and during the period of Bid's validity;

(b) if the bidder does not accept the correction of its bid price, pursuant to Sub-Clauses 29.1 and 35.1; or

(c) in the case of a successful bidder, if it fails within the specified time limit to

(i) sign the Contract Agreement, or

(ii) furnish the required performance security,

The costs of the Bid Security and the cost of any extension of it shall be borne by the bidder.

20. Alternative Proposals by Bidders

20.1 Bidders shall submit offers which comply with the documents including the basic Employer's Requirements as indicated in the bidding documents. Alternatives will not be considered. The attention of bidders is drawn to the provisions of Clause 30 regarding the rejection of bids which are not substantially responsive to the requirements of the bidding documents.

21. Pre-Bid Meeting

21.1 The bidder or its official representative is invited to attend a

pre-bid meeting at Grenade Wind Farm, Rodrigues Island on Tuesday 19 November 2019 at 10.00 hrs. The bidders shall then be allowed to take cognizance of the site conditions on the same date.

21.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

21.3 Not Applicable.

21.4 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any response prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document from the sources indicated in the Invitation for Bids. Any modification of 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 12.2 and not through the minutes of the pre-bid meeting.

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

21.6 Organization of the meeting's participation and expenses related to these meetings are Bidder's sole responsibility and charges.

22. Format and Signing of Bid

22.1 The bidder shall prepare one original (hard copy), one copy of the original, and one electronic (USB key) copy of the technical proposal and financial proposal, comprising the bid as described in Clause 14 of these Instructions to Bidders, and clearly marking each one as: "ORIGINAL- TECHNICAL PROPOSAL", "ORIGINAL PRICE PROPOSAL", and "COPY NO. 1 – TECHNICAL PROPOSAL", "COPY NO 1 FINANCIAL PROPOSAL" etc. as appropriate. In the event of discrepancy between them, the original shall prevail.

22.2 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, photocopies are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder, pursuant to Sub-Clauses 6.1 (a). All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.

22.3 The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.

22.4 The bidder shall furnish information as described in the Form of Bid on commission or gratuities, if any, paid or to be paid relating to this Bid, and to contract execution if the bidder is

awarded the contract.

D. Submission of Bids

23. Sealing and Marking of Bids

23.1 The bidder shall seal the original copy of the technical proposal, the original copy of the price proposal and each copy of the technical proposal and each copy of the price proposal in separate envelopes clearly marking each one as: “ORIGINAL TECHNICAL PROPOSAL”, ÖRIGINAL PRICE PROPOSAL”, “and COPY NO. 1 – TECHNICAL PROPOSAL”, “COPY NO 1- PRICE PROPOSAL” etc. as appropriate.

23.2 The Bidder shall seal the original bids and each copy of the bids in an inner and an outer envelope, duly marking the envelopes as “ORIGINAL” and “COPY” .

23.3 The inner and outer envelopes shall

(a) be addressed to the Employer at the following address:

The Chairman Tender Committee Central Electricity Board, Royal Road, Curepipe, Mauritius ; and

(b) bear the following identification:

- Bid for: **Design, Supply, Installation, Testing and Commissioning of 1MWac Solar PV Farm at Grenade, Rodrigues.**
- **Bid Reference Number: OAB-PROD 4324**

DO NOT OPEN BEFORE 13.30 hrs **(Mauritian time)** on **Wednesday 11 December 2019**

23.4 In addition to the identification required in Sub-Clause 23.3, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Clause 25.

23.5 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

24. Deadline of Submission of Bid

24.1 Bids must be received by the Employer at the address specified above no later than 13.30 hrs **(Mauritian time)** on **Wednesday 11 December 2019**

24.2 The Employer may, at its discretion, extend the deadline for submission of bids by issuing an addendum in accordance with Clause 12, in which case all rights and obligations of the

Employer and the bidders previously subject to the original deadline will thereafter be subject to the extended new deadline.

25. Late Bids

25.1 Any bid received by the Employer after the deadline for submission of bids prescribed in Clause 24 will be rejected and returned unopened to the bidder.

26. Modification and Withdrawal of Bid

26.1 The bidder may modify or withdraw its bid after bid submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline for submission of bids.

26.2 The bidder's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause 23, with the outer and inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL", as appropriate. A withdrawal notice may also be sent by fax but must be followed by a signed confirmation copy.

26.3 No bid may be modified by the bidder after the deadline for submission of bids, except in accordance with Sub-Clauses 26.2.

26.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified In Sub-Clause 18.1 may result in the forfeiture of the bid security pursuant to Sub-Clause 19.6.

E. Opening and Evaluation of Technical Proposal

27. Bid Opening

27.1 The Employer will open the technical proposal, including modifications made pursuant to Clause 26, in the presence of bidders representatives who choose to attend, at the following address:

Central Electricity Board, Committee Room, 3rd Floor, New Building, Royal Road, Curepipe.

Bids shall be opened at the address mentioned above on Wednesday **11 December 2019 as from 13.45 hours (Mauritian time).**

27.2 The bidders' representatives who are present shall sign a register evidencing their attendance.

The price proposals will remain unopened and will be held in the custody of the Employer until the time of bid opening of the price proposals after evaluation of the technical proposals. The time and date and location of the bid opening will be communicated in writing or by fax by the Employer.

	27.3	Envelopes marked “"WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 26 shall not be opened.
	27.4	The bidders' names, bid modifications and withdrawals, the presence or absence of bid security or bid securing declaration, and such other details as the Employer may consider appropriate, will be announced and recorded by the Employer at the opening.
	27.5	The Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with Sub-Clause 27.4.
28. Process to Be Confidential	28.1	Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process. Any effort by a bidder to influence the Employer's processing of bids or award decisions may result In the rejection of the bidder's bid.
29. Clarification of Technical Proposals and contacting the Employer	29.1	To assist in the examination, evaluation and comparison of bids, the Employer may, at its discretion, ask any bidder for clarification of its bid. The request for clarification and the response shall be in writing or by fax, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids in, accordance with Clause 37.
	29.2	Subject to Sub-clause 29.1, no bidder shall contact the Employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded. If the bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.
	29.3	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.
	29.4	Any effort by the bidder to influence the Employer in the employer's evaluation of technical proposals, bid comparison or the Employer's decisions on acceptance or rejection of bids may result in the rejection of the bidder's bid.
30. Preliminary Examination of Technical Proposals and Determination of Responsiveness	30.1	Prior to the detailed evaluation of the technical proposals, the Employer will determine whether each bid (i) meets the eligibility criteria of the Public Body; (ii) has been properly signed; (iii) is accompanied by the required securities; (iv) is substantially responsive to the requirements of the bidding documents; and (v) provides any clarification and/or substantiation that the Employer may require pursuant to

Clause 29, and (vi) complies with the Requirements **((a)-(d))** which are listed hereunder:

(a) The Technical Proposal Form must be duly signed and submitted as per format provided.

(b) The required Bid Security shall submitted as per the formats provided,

(c) Time for Completion of works for each Section of the project shall be according to ITB 1.2. Proposals with Time of Completion exceeding those times shall be rejected

(d) The Bid must comply with the requirements of the Bidding documents including Schedules of Payment. If any Bidder has deviated to a substantial degree from the specified commercial or technical requirements, or if the equipment offered is of an inferior technical quality then his Bid shall be rejected. Minor deviations may however be accepted.

Bids which do not comply with any of the above conditions shall be rejected

30.2 A substantially responsive bid is one which conforms to all the terms, conditions and requirements of the bidding documents, without material deviation or reservation.

A material deviation or reservation is one:

(i) which affects in any substantial way the scope, quality or performance of the Works;

(ii) which is inconsistent with the bidding documents and limits in any substantial way, the Employer's rights or the bidder's obligations under the Contract; or

(iii) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

30.3 If a bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

31. Evaluation and Comparison of Technical Proposals

31.1 The Employer will carry out a detailed evaluation of the bids in order to determine whether the bidders are qualified and whether the technical aspects are substantially responsive to the requirements set forth in the bidding documents. In order to reach such a determination, the Employer will examine the information supplied by the Bidders and other requirements in the bidding documents, taking into account the following factors:

(a) Qualification

(I) the determination will take into account the Bidder's financial, technical and production capabilities and past performance; it will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to Sub-Clause 6.1(b), as well as such other information as the Employer deems necessary and appropriate; and

(ii) an affirmative determination will be a prerequisite for the Employer to continue with the evaluation of the technical proposal; a negative determination will result in rejection of the Bidder's bid.

(b) Technical

(I) overall completeness and compliance with the Employer's Requirements; the technical merits of plant and equipment offered and deviations from the Employer's Requirements; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing at the site; quality, function and operation of any process control concept included in the bid;

(ii) achievement of specified performance criteria by the facilities;

(iii) compliance with the time completion schedule provided in these bidding documents;

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

(v) Technical Evaluation as per the marking system described in Section 1A and in Employer's Requirements, and;

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(vi) conformity to the guaranteed particulars of the equipment and services being offered. The guaranteed particular sheets should be duly filled and signed;

(vii) any deviations to the commercial and contractual provisions stipulated in the bidding documents.

32. Invitation to

32.1 At the end of the evaluation of the technical proposals the

Attend Opening of Price Proposals

Employer will invite bidders who have submitted substantially responsive technical proposals and who have been determined as being qualified for further evaluation, to attend the bid opening of the price proposals. Bidders shall be given reasonable notice of the price proposal bid opening.

32.2 The Employer will notify unsuccessful Bidders on the grounds of being substantially non-responsive to the requirements of the bidding documents and return the unopened price proposal after the selection process is complete.

F. Opening and Evaluation of Price Proposals

33. Opening of Price Proposals

33.1 The Employer will open the price proposals of all bidders, who submitted substantially responsive technical proposals and qualified for further evaluation, at the time and date and at the location advised to the bidders. The bidder's representatives who are present shall sign a register evidencing their attendance.

33.2 The bidder's names, the Bid Prices, any discounts, and such other details as the Employer may consider appropriate, will be announced and recorded by the Employer at the opening.

33.3 The Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with Sub-Clause 33.2.

34 Process to be Confidential

34.1 Information relating to the examination, clarification, evaluation and comparison of bids and recommendation for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of the bidder's bid.

35 Clarification of Price Proposals and Contacting the Employer

35.1 To assist in the examination, evaluation and comparison of price proposals, the Employer may, at its discretion, ask any bidder for clarification of its bid. The request for clarification and the response shall be in writing or by electronic mail, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids in accordance with Clause 37.

35.2 Subject to Sub-Clause 35.1, no bidder shall contact the Employer on any matter relating to its bid from the time of opening of price proposals to the time the contract is awarded. If the bidder wishes to bring additional information to the notice of the employer, it should do so in writing.

35.3 Any effort by the bidder to influence the Employer in the Employer's evaluation of price proposals, bid comparison or contract award decisions may result in the rejection of the

bidder's bid.

36. Preliminary Examination of Price Proposals and Determination of Responsiveness

36.1 The Employer will examine the bids to determine whether they are complete, whether the documents have been properly signed, whether the bids are substantially responsive to the requirements of the bidding documents; and whether the bids provide any clarification and/or substantiation that the Employer may require pursuant to Clause 35.

36.2 A substantially responsive bid is one which conforms to all the terms, conditions and requirements of the bidding documents, without material deviation or reservation, and includes the amendments and changes, if any, requested by the Employer during the evaluation of the bidder's technical proposal.

36.3 If a price proposal is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

37. Correction of Errors

37.1 Price Proposals determined to be substantially responsive will be checked by the Employer for any arithmetical errors. Arithmetical errors will be rectified on the following basis:

(a) If there is a discrepancy between the unit rate and the total cost that is obtained by multiplying the unit rate and quantity, the unit rate shall prevail and the total cost will be corrected unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit rate, in which case the total cost as quoted will govern and the unit rate corrected.

(b) If there is a discrepancy between the total bid amount and the sum of total costs, the sum of the total costs shall prevail and the total bid amount will be corrected.

37.2 The amount stated in the Form of Bid for Price Proposal will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount of bid, its bid will be rejected, and the bid security may be forfeited in accordance with Sub-Clause 19.6(b) respectively.

38. Conversion to Single Currency

38.1 The Employer will convert the amounts in various currencies in which the Bid Price is payable to the currency of the Employer's country (MUR) using the TT selling exchange rates officially prescribed for similar transactions as established by Bank of Mauritius (www.bom.mu) on the date of opening of the Technical bids.

39. Evaluation and Comparison of Price Proposals

39.1 The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 36.

39.2 For plant and equipment, the comparison shall be of the ex-factory price of plant and equipment offered from within the Employer's country, (such price to include all costs as well as duties and taxes paid or payable on components .and raw material or to be incorporated in the plant and equipment) and the CIF-named port of destination price offered from outside the Employer's country; plus duties and taxes payable, the cost of local transportation, civil works, installation and other services required under the contract. The Employer's comparison will also include the costs resulting from application of the evaluation procedures described in Sub-Clause 39.4.

39.3 Deleted

39.4 Pursuant to Sub-Clause 39.3, the following evaluation methods will be followed:

(a) **Time Schedule:** The plant and equipment covered by this bidding are required to be shipped, installed and the facilities completed within the period specified in Sub-Clause 1.2 and the Appendix to the Technical Proposal.

Bidders submitting bids which deviate from the time schedule specified will be rejected.

No credit will be given to earlier completion.

The price of recommended spare parts quoted in Schedule of Prices: VI shall be considered for evaluation.

39.5 (a) Any adjustment in price which results from the above procedures shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price": The Grand Total Bid prices quoted by Bidders shall remain unaltered.

(b) The Employer reserves the right to accept or reject any variation, deviation or alternative offer. Variations, deviations, and other factors which are in excess of the requirements of the bidding documents or otherwise result in the accrual of unsolicited benefits to the Employer shall not be taken into account in bid evaluation.

(c) The estimated effect of the price adjustment provisions of the Conditions of Particular Application, applied over the period or execution of the Contract, shall not be taken in bid evaluation.

(d) If the bid of the successful bidder is substantially below the Employer's estimate for the contract, the Employer may require the bidder to produce detailed price analysis to demonstrate the internal consistency of those prices. After evaluation of the price analysis, the Employer may:

(i) require that the amount of the performance security set forth in Clause 45 be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the Contract; or

(ii) if the Employer still has concerns as to the ability of the bidder to perform the procurement contract, it may reject the bid.

(e) If the bid for an admeasurement contract, which results in the lowest Evaluated Bid Price, is seriously unbalanced or front loaded or if any item in the priced Activity Schedule is front loaded or contains an erroneous amount in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analysis for any or all items of the Bill of Quantities or Priced Activity Schedule, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After analysis of the prices 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. Margin of Preference

40.1 A Margin of Preference is not Applicable

G. Award of Contract

41. Award

41.1 Subject to Clause 42, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and whose bid has scored the highest marks for the Technical and Financial assessment combined, provided that such bidder has been determined to be (i) eligible in accordance with the provisions of Clause 4; and (ii) qualified in accordance with the provisions of Clause 6.

42. Employer's Right to Accept any Bid and to Reject any or all Bids

42.1 Notwithstanding Clause 41, 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 award of Contract, without thereby incurring any liability to the affected bidder or bidders.

(a) In line with Government Decision, the Public Body shall,

42A Tax Clearance applicable to local bidders only

42.2 prior to award, request the lowest substantially responsive bidder to submit a ***"Tax Clearance Certificate"*** from the Mauritius Revenue Authority (MRA) within a period of one week, confirming that the bidder has filed his tax returns and paid tax due.

(b) In case the successful bidder does not submit the ***"Tax Clearance Certificate"*** the Public Body may consider the next lowest substantially responsive bidder to equally comply with Paragraph (a) above.

(c) It is brought to the attention of the bidders that MRA put in place a system for responsive bidders, on receipt of a letter from a Public Body requesting for a Tax Clearance Certificate, to apply for same electronically on MRA website www.mra.mu. The bidder is requested to use the reference of the letter issued by the Public Body to access the system.

43. Notification of Award

43.1 Following the identification of the selected bidder and subject to the notification and the time period referred to in accordance with section 40 of the Act for major contracts, the Public Body shall, prior to expiration of bid validity period, issue award to the successful Bidder. The Employer will:

(a) notify the successful bidder by fax, confirmed by registered letter, that its bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") shall name the sum which the Employer will pay the Contractor in consideration of the Design, Manufacture, Supply, Installation, Testing and Commissioning of the 1MWac PV system by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called "the Contract Price").

(b) within seven days from the issue of Letter of Acceptance, publish on the Public Procurement Portal (publicprocurement.govmu.org) and the Employer's website, the results of the Bidding Process identifying the bid and lot numbers and the following information:

(i) name of the successful Bidder, and the Price it offered, as well as the duration and summary scope of the contract awarded; and

(ii) an executive summary of the Bid Evaluation Report.

43.2 The notification of award will constitute the formation of the Contract.

43.3 Upon the furnishing by the successful bidder of a performance security and preference security (where applicable) the Employer will promptly notify the other bidders that their bids have been unsuccessful.

44. Signing of Contract Agreement	44.1	At the same time that he notifies the successful bidder that its bid has been accepted, the Employer will send the bidder the Form of Contract Agreement provided in the bidding documents, incorporating all agreements between the parties.
	44.2	Within 28 days of receipt of the Form of Agreement, the successful bidder shall sign the Form and return it to the Employer.
45. Performance Security	45.1	Within 28 days of receipt of the Letter of Acceptance from the Employer, the successful bidder shall furnish to the Employer a Performance Security in an amount of 10% percent of the total Contract Price in accordance with the Conditions of Contract. The format of performance security is provided in Section 6 of the bidding documents. The Performance Security shall be issued by a Commercial Bank operating in Mauritius and shall be valid 60 days beyond the date of issuance of the Taking Over Certificate.
	45.2	Failure of the successful bidder to comply with the requirements of Clauses 44 or 45 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security or execution of the bid securing declaration whichever is applicable.
Preference Security	45.3	Not Applicable
46. Debriefing	46.1	The Employer shall promptly attend to all debriefing for the contract made in writing and within 30 days from the date of the publication of the award or date the unsuccessful bidders are informed about the award, whichever is the case by following regulation 9 of the Public Procurement Regulations 2008 as amended.

1.1 - Section 1 A - Evaluation and Qualification Criteria

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders. In accordance with ITB 37 and ITB 39, no other factors, methods or criteria shall be used. The Bidder shall provide all the information requested in the forms included in Section V, Bidding Forms.

1.2 Evaluation of Technical Offer

Bids will be evaluated on the basis of the qualification criteria and a marking system as defined hereunder

2. Eligibility and Qualification

Eligibility and Qualification Criteria				Compliance Requirements			Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
2.1 Eligibility							
2.1.1	**Nationality**	Nationality in accordance with ITB 4.1	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI –1.1 and1.2, with attachments
2.1.2	**Conflict of Interest**	No conflicts of interest in accordance with ITB 4.3	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Bid Form for Technical & that for Financial Proposals
2.1.3	**Country's Eligibility**	Not having been declared ineligible by the Republic of Mauritius or any other institutions as described in ITB 4.4 (a) & (b)	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Bid Form for Technical Proposal
2.1.4	**Government Owned Entity**	Compliance with ITB 4.5	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Forms ELI – 1.1 and ELI- 1.2, with attachments
2.1.5	**Registration with the CIDB**	For this project, the Bidder should be duly registered with the CIDB in Mechanical, Electrical and Plumbing Works, and Building Construction Works	Must meet requirement	Must meet requirement		N/A	Copies of valid Registration Certificate from CIDB

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		under the Grade that would allow the bidder to perform the value of works for which it is submitting its bid as described in ITB 4.7 and with field of specialization as stipulated in ITB 6.1 (c)					

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
2.2 Historical Contract Non-Performance							
2.2.1	**History of Non-Performing Contracts[6]**	Non-performance of a contract[7] did not occur as a result of contractor's default since 1st January 2014.	Must meet requirement	Must meet requirement	Must meet requirement[8]	N/A	Form CON-1
2.2.2	**Suspension Based on Execution of Bid Securing Declaration by the employer**	Not under suspension based on execution of a Bid Securing Declaration.	Must meet requirement	N/A	Must meet requirement	N/A	A duly signed written Declaration
2.2.3	**Litigation History**	No consistent history of court/arbitral award decisions against the Bidder since 1 January 2008.	Must meet requirement by itself or as partner to past or existing JV.	N/A	Must meet requirement by itself or as partner to past or existing JV.	N/A	Form CON – 2

[7] Non performance, as decided by the employer, shall include all contracts where (a) non performance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract, and (b) contracts that were so challenged but fully settled against the contractor. Non performance shall not include contracts where employers decision was overruled by the dispute resolution mechanism. Non performance must be based on all information on fully settled disputes or litigation, i.e. dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the applicant have been exhausted.

[8] This requirement also applies to contracts executed by the Bidder as JV member.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
2.3 Financial Situation and Performance							
2.3.1	**Financial Capabilities**[9]	(i) The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the cash flow requirements estimated as **USD $ 700,000 (equivalent to MUR 25,200,000)** for the subject contract(s) net of the Bidders other commitments	Must meet requirement	Must meet requirement	N/A	N/A	Form FIN – 1 and FIN 3 with attachments
		(ii) The audited balance sheets or, if not required by the laws of the Bidder's country, other	Must meet requirement	N/A	Must meet requirement	N/A	

[9] Local bidders who are not required to file Audited Accounts should submit copies of Financial Statements filed at the Registrar of Companies prior to deadline set for the submission of bids.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		financial statements acceptable to the Employer, for the last **5 years** shall be submitted and must demonstrate the current soundness of the Bidder's financial position.					
2.3.2	**Average Annual Construction Turnover**	Minimum average annual turnover of **USD 1,500,000 (equivalent to MUR 54,000,000)** calculated as total certified payments received for contracts in progress and/or completed within any 5 years over the last 10 years , starting 1st January 2008.	Must meet requirement	Must meet requirement	N/A	N/A	Form FIN –2
2.4 Experience							
2.4.1	**General Experience in Design, Supply, Installation, Testing and Commissioning of Ground-Mounted Solar PV Farms**	Experience under contracts in the role of prime contractor – EPC contractor, JV member, specialized sub-contractor, for at least 5 projects over the **last**	Must meet requirement	N / A	N/A	Must meet	Form EXP-1 and EXP- 2

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		ten years, starting 1st January 2008.				requirement	
2.4.2 (a)	**Specific Experience in Design, Supply, Installation, Testing and Commissioning of Ground-Mounted Solar PV Farms**	A minimum number of similar[10] contracts specified below that have been satisfactorily and substantially[11] completed as a prime contractor, joint venture member[12], or specialized sub-contractor[12]since 1st January 2008 (i) at least 1 contract of value more than USD 1,000,000 (USD one Million), OR at least 2 contracts, each of minimum value of USD 500,000 (USD five	Must meet requirement	Must meet requirement	N / A	N / A	FORM EXP-3 and EXP-4

[10] The similarity shall be based on the complexity, methods/technology and/or other characteristics described in Section IV, Employer's Requirements. Summation of number of small value contracts (less than the value specified under requirement) to meet the overall requirement will not be accepted.

[11] Substantial completion shall be based on 80% or more works completed under the contract.

[12] For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share, by value, shall be considered to meet this requirement.

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		hundred thousand)					
		(ii) For the following specialized works, the Employer shall take into account the qualification of the Bidder`s specialized sub-contractors in the following areas: (a) supply, installation, testing and commissioning of 11kV (or higher voltage) metal clad switchgears. (b) supply, installation, testing and commissioning of at least five 0.5 MVA or higher step up transformers with secondary voltage of 11kV or higher (c) Supply and implementation of a	Subcontractor must meet requirement for at least 2 contracts	Subcontractor must meet requirement for at least 2 contract			

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		SCADA System for PV Systems of at least 0,5MWac Capacity. The Bidder to provide all necessary information as type, capacity, duty conditions, etc. to demonstrate compliance with the Employer's Requirements and full information about the qualification of the proposed sub-contractors.					
2..4.2 (b)	**key Activities**	For the above and any other contracts completed and under implementation as prime contractor joint venture member, or specialized sub-contractor a minimum experience in the following key activities successfully completed[13]:					FORM EXP-5 and EXP-6

13

Eligibility and Qualification Criteria			Compliance Requirements				Documentation
No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Parties Combined	Each Member	Lead Member	
		a) A minimum cumulative installed capacity of 10MW Ground Mounted PV Solar Systems over the last ten years.	Must meet requirements	N/A	N / A	Must meet requirement	
		b) at least three Ground Mounted PV Solar Systems each of 0.5MWac capacity or higher over the last five years.	Must meet requirements	N/A	N/A	Must meet requirement	

2.5 Key Personnel

The Bidder must demonstrate that it will have the personnel for the key positions that meet the following requirements:

	Position	**Minimum of Years of working Experience**
1	Project Manager	7
2	Site Engineer	5
3	Civil Engineer	5
4	Commissioning Engineer	5

The adequacy of the qualification of the Key Personnel will be assessed on the following

Project Manager	The project manager shall be responsible for the management of whole project including the supply, installation, coordination with the CEB, testing and commissioning of the installation of Photovoltaic system. He shall have the following minimum qualification: - A degree in Electrical or Electronic Engineering or equivalent - Has successfully completed the implementation of five(5) such similar projects. .
Site Engineer	The Site Engineer shall be responsible for the supervision of the installation, testing and commissioning of the system on site and coordination of works with the CEB for the interconnection of the system to the existing services. - A degree in Electrical or Electronic Engineering or equivalent Has successfully completed the implementation of two similar projects.
Civil Engineer	The Civil Engineer shall be responsible for the supervision of the Civil Works on site and coordination of works with the CEB. - A degree in Civil Engineering.
Commissioning Engineer	The commissioning engineer shall be responsible for the commissioning of the photovoltaic system and all other associated equipment on site. - A degree in Electrical or Electronic Engineering or equivalent. - Has successfully completed the implementation of two similar projects.

2.6 Equipment

The Bidder must demonstrate that it will have access to the equipment listed hereafter for Civil Works:

No.	Equipment Type and Characteristics	Minimum Number required
1	Concrete mixer with weight batcher (100 kg)	1
2	Vibrating Roller (12T-20T)	1
3	Excavator – 175 HP	1
4	Backhoe Loader (10T)	1
5	Lorries 10T capacity	1

The Bidder shall provide further details of proposed items of equipment for civil works, and installations of containers using the Forms in Section V. Bidding Forms.

2.7 Assessment of Adequacy of Technical Proposal as per Requirements

Only bids submitted by qualified and eligible bidders will be considered for the Technical Evaluation.

The Technical Offers will be examined on the basis of the information supplied by Bidders, taking into account the completeness, consistency and level of detail provided.

Provided the Technical Proposal is responsive to the Employer's Requirement including PART A below following the preliminary and detailed examination, they will be compared as per a marking system as provided in PART B below.

Part A – Determination of Technical Responsiveness

	Responsiveness of Bids				
	Bid Responsiveness		Compliance Requirements		Documentation
No.	Subject	Requirement	Bid Submitted in Single Entity	Bid Submitted by JV	Submission Requirements
1	**Types of PV Panels**	The PV panels shall be of mono-crystalline type.	Must meet requirement	Must meet requirement	Technical Schedule- Sheet 1
2	**PV Module Output Capacity**	Each PV module output shall lie mandatorily between 300 and 385 Wp.	Must meet requirement	Must meet requirement	Technical Schedule- Sheet 1
3	**Warranty on PV Module**	The bidder shall provide warranty on PV panels for 10 years	Must meet requirement	Must meet requirement	Technical Schedule- Sheet 1
4	**PV Module Degradation**	The output of the PV panels shall not degrade more than 11% at the end 12 years. Manufacturer's datasheet shall be provided to confirm same.	Must meet requirement	Must meet requirement	Technical Schedule- Sheet 1

	Responsiveness of Bids				
	Bid Responsiveness		Compliance Requirements		Documentation
No.	Subject	Requirement	Bid Submitted in Single Entity	Bid Submitted by JV	Submission Requirements
5	**PV Cell Efficiency**	The efficiency of the PV cell, shall be equal to or greater than 17% under Standard Test Conditions (STC) and AM 1.5 radiations.	Must meet requirement	Must meet requirement	Technical Schedule- Sheet 1
6	**Compliance Certificates for PV panels**	Copy of IEC Compliance Certificates for PV panels from an independent laboratory- latest editions of: IEC 62804 – 1 IEC 61215-1 IEC 61215-2 IEC 61701 IEC 61730 - 1 IEC 61730 – 2 IEC 61853-1 EN50380 IEC 62979	Must meet requirement	Must meet requirement	Copy of Certificates for Modules appended to Technical Schedule- Sheet 1
7	**Compliance Certificate for Inverters**	Copy of IEC Compliance Certificates for Inverters from an independent laboratory - with: latest editions of: IEC 62894 IEC 62109-1 IEC 62109-2 IEC 62109-3 IEC TS 62910 IEC 62920 IEC 61683 IEC 62116 IEC 60529 IEC 62852	Must meet requirement	Must meet requirement	Copy of Certificates for Modules appended to Technical Schedule- Sheet 2
8	**Warranty on Inverters**	The bidder shall provide a warranty of 10 years on Inverters used in this project	Must meet requirement	Must meet requirement	Statements from respective PV Manufacturer and Bidder

	Responsiveness of Bids				
	Bid Responsiveness		Compliance Requirements		Documentation
No.	Subject	Requirement	Bid Submitted in Single Entity	Bid Submitted by JV	Submission Requirements
9	**Spare Parts**	Bidder shall provide list of spares as requested in Employer Requirements Section 3.41.2 and 3.41.3	Must meet requirement	Must meet requirement	
10	**Compliance with IEC & Other Standards**	The bidder shall have to sign and submit the list of IEC Standards and other standards provided throughout the document.	Must meet requirement	Must meet requirement	As per Employer`s requirements
11	**Time of Completion**	The bidder shall complete the project within 12 months as from the Commencement Date	Must meet requirement	Must meet requirement	Project Time Schedule
12	**Withstanding of Wind Gusts of 280 km/hr for a period of 3 Seconds**	All PV Arrays, including PV mounting Structures, buildings and other structures to be constructed by the Bidder shall be designed to resist Cyclonic Gusts of 280km/hr for a period of 3 Sec as per BS-CP 3 Standard.	Must meet requirement	Must meet requirement	Statement from Bidder.
13	**Guaranteed Power Output**	The Guaranteed Power Output shall be an AC output of 1MWac measured at the Point of Common Coupling (PCC)	Must meet requirement	Must meet requirement	Statement from Bidder. Single Line Diagram
14	**Technical Data Sheets**	Bidder has duly filled all the technical data sheets provided in Technical Schedules List	Must meet requirement	Must meet requirement	Completed Technical Schedules List

Part B – Marking System

a. Technical Evaluation

The technical criteria and the corresponding markings are provided in the Table 3.0 below:

Table 3.0

Technical Criteria	Marks
PV Cell Efficiency (%) - *under conditions described in Clause 6.4 of the Employer`s Requirement.*	20
PV Module Power Guarantee after 25 years (%)	20
Temperature Coefficient Pmax (%)	20
Inverter Maximum Efficiency (%)	20
Step Up Transformer Losses (%)	20
Total	**100**

1. PV Cell Efficiency

The performance of the PV cell shall be measured under standard temperature and conditions (STC) with irradiance of 1 kW/m², a spectral distribution close to solar radiation through AM (air mass) of 1.5 and a cell temperature 25 °C. The cell efficiency must be provided in the Manufacturer's datasheet.

Bidders offering PV cell with highest efficiency shall score twenty (20) marks. The bidder offering a PV cell efficiency at 17% shall score twelve (12) marks. The remaining bidders shall be pro-rated.

Bidders offering a PV cell efficiency of less than 17% shall score zero marks.

2. Module Power Guarantee

The bidder shall provide in Sheet 1 of the Technical Schedules, the module power guarantee after a period of 25 years, in terms of percentage. This figure shall be provided by the solar PV Manufacturer in its datasheet.

Bidders offering the PV module with the highest module power guarantee after a period of 25 years shall score twenty (20) marks. On the other hand, bidders offering PV module with the power guarantee after a period of 25 years equivalent to 80% shall score twelve (12) marks. The markings for the remaining values for annual degradation factor shall be based on pro-rata basis.

Bidders offering PV module with the power guarantee after a period of 25 years equivalent to less than 80% shall score zero(0) marks.

3. Temperature Coefficient (Pmax)

The bidder shall have to provide the temperature coefficient (Pmax) of the propose modules in Sheet 1 of the Technical Schedules**.** This figure shall also confirmed in the Manufacturer datasheet.

Bidders offering the lowest temperature coefficient (Pmax) shall score twenty (20) marks. On the other hand, bidders offering modules with temperature coefficient (Pmax) equivalent to -0.5%/°C shall score twelve (12) marks. The markings for the remaining values for temperature coefficient (Pmax) shall be based on pro-rata basis.

Bidders offering modules with temperature coefficient (Pmax) of higher than -0.5%/°C shall score zero(0) marks.

4. Inverter Maximum Efficiency

The bidder shall have to provide the inverter maximum efficiency which shall also confirmed in the Manufacturer datasheet.

Bidders offering the highest inverter efficiency shall score twenty (20) marks. On the other hand, bidders offering inverter efficiency equivalent to 97.5% shall score twelve (12) marks. The markings for the remaining values for inverter efficiencies shall be based on pro-rata basis.

Bidders offering inverter efficiency of less than 97.5% shall score zero (0) marks.

5. Step up Transformer Losses

The bidder shall have to provide the step up transformer losses (both copper and core losses and figures shall also be confirmed in the Manufacturer datasheet.

Bidders offering the lowest transformer losses shall score twenty (20) marks. On the other hand, bidders offering highest transformer losses shall score twelve (12) marks. The markings for the remaining values for transformer losses shall be based on pro-rata basis.

Note:
The minimum technical score St required to pass is **60** marks. **A score of zero in any one or more of the above technical criteria and sub-criteria will not be considered for Financial Evaluation. The Bid will be considered as non-responsive.**

The formula for determining the financial scores is the following:

$S_f = 100 \times F_m / F$, in which S_f is the financial score, F_m is the lowest price and F the price of the proposal under consideration.

The weights given to the Technical and Financial Proposals are:

Technical = 70%, and Financial = 30%

The markings obtained for both the Technical and financial shall be added together to determine the best evaluated bid.

Section 2. Part I – General Conditions of Contract

Section 2. Part I – General Conditions

Notes on the Conditions of Contract

The Conditions of Contract comprise two parts: Part I – General Conditions (Section 2 of this document), and Part II – Conditions of Particular Application (Section 3 of this document) as per FIDIC Plant and Design Build First Edition 1999.

The standard text of the FIDIC General Conditions of contract should be retained intact to facilitate its reading and interpretation by bidders. Any amendments and additions to the General Conditions, specific to the contract in hand, should be introduced in the "Particular Conditions of Contract". Sample Particular Conditions, applicable to the above FIDIC Conditions of Contract some of which have been adopted from the Standard Bidding Document of Millennium Challenge Corporation of United States of America, are included under Section 3, for ease of bidding documents preparation. The Public Body should not consider these sample Particular Conditions as exhaustive as it is its responsibility to amend these conditions to best suit the particular project.

Copies of the FIDIC Conditions of Contract can be obtained from:

FIDIC Secretariat
P.O. Box 86
1000 Lausanne 12
Switzerland
Facsimile: 41 21 653 5432
Telephone: 41 21 653 5003

Section 3. Part II –Conditions of Particular Application

1. General Provisions

Sub-Clause 1.1.1 The Contract	Amend Subpara. 1.1.1.1 ("Contract") by adding the following at the end: "The words 'Agreement' and 'Contract' are used interchangeably." Amend Subpara. 1.1.1.8 ("Tender") by adding the following at the end: "The word 'tender' is synonymous with 'Bid,' and the words 'Letter of Tender' with 'Letter of Bid', and the words 'Appendix to Tender' with 'Appendix to Bid,' and the words 'tender documents' with 'Bidding Documents.'"
Sub-Clause 1.1.3 Dates, Tests, Periods and Completion	Replace the text of Sub-Para. 1.1.3.1 with the following text: "Base Date" means the date 21 days prior to the latest date for submission of the Tender" Amend Sub-Para. 1.1.3.7 by inserting the following after the reference to Sub-Clause 11.1: "which extends over twelve months except if otherwise stated in the Appendix to Bid".
Sub-Clause 1.4	Replace the text of Sub-Clause 1.4 and add the following: "The law of the Contract is the law of Mauritius." "The language is the English language"
Sub-Clause 1.5 Priority of Documents	Delete the list of documents listed under (a) to (h) and add the following: "(a) the Contract Agreement; (b) the Letter of Acceptance; (c) the Employer's Requirements; (d) the Bid; (e) the Conditions of Contract, Part II; (f) the Conditions of Contract, Part I; (g) the Schedules; (h) the Drawings; and (i) the Contractor's Proposal."
Sub-Clause 1.12 Confidential Details	Replace the text of Sub-Clause 1.12 with the following: "The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation; provided that the requirements of this Sub-Clause 1.12 shall not apply to authorized Representatives of the Employer and the Employer's Audit.

	"Each of the Parties shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the design and of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or, with the prior consent of the Employer, information otherwise reasonably required to establish its qualifications to compete for other projects. If any dispute arises as to the necessity of any publication or disclosure of the details of the Contract, the same shall be referred to the Employer whose determination shall be final. The Contractor shall ensure that the requirements imposed on the Contractor by this Sub-Clause apply equally to each Subcontractor."
Sub-Clause 1.13 Compliance with Laws	Amend Sub-Clause 1.13(b) by adding the following at the end: "unless the Contractor is impeded to accomplish these actions and shows evidence of its diligence."

3. The Engineer

Sub-Clause 3.1 Engineer's Duties and Authority	Amend Sub-Clause 3.1 by replacing the word "may" in the first sentence of the third paragraph with the word "shall". Amend Subpara. (b) of Sub-Clause 3.1 by deleting the word "and" at the end. Amend Subpara. (c) of Sub-Clause 3.1 by replacing the period at the end with "; and". Amend Sub-Clause 3.1 by adding the following at the end: "(d) any act by the Engineer in response to a Contractor's request except otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt. "The following provisions also shall apply: "The Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions: (i) Sub-Clause 4.12 [*Unforeseeable Physical Conditions*]: Agreeing to or determining an extension of time and/or additional cost. (ii) Sub-Clause 10.1 [*Taking-over of the Works and Sections*]: Prior to issuing Taking-Over Certificate. (iii) Sub-Clause 11.9 [*Performance Certificate*]: Prior to issuing Performance Certificate. (iv) Sub-Clause 13.1 [*Right to Vary*]: Instructing a Variation, except if such a Variation would increase the Accepted Contract

Amount by less than the percentage specified in the Appendix to Bid.

(v) Sub-Clause 13.3 [*Variation Procedure*]: Approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.1 [*Right to Vary*] or 13.2 [*Value Engineering*], except if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Appendix to Bid.

(vi) Sub-Clause 13.4 [*Payment in Applicable Currencies*]: Specifying the amount payable in each of the applicable currencies.

"Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. Within 7 days of having issued such emergency instructions, the Engineer shall submit written documentation of such instructions to the Employer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 [*Variations and Adjustments*] and shall notify the Contractor accordingly, with a copy to the Employer."

4. The Contractor

Sub-Clause 4.1
Contractor's General Obligations

(a) Add the following sentence to precede the existing text under Sub-Clause 4.1:

"The Contractor is required to check the design criteria and calculations (if any) included in the Employer's Requirements, to confirm their correctness, in its bid and to assume full responsibility for them."

'**Amend** sub-clause **4.1** by adding the following at the end'.

"The Contractor and its Subcontractors, including their respective personnel and affiliates, shall at all times during the term of this Contract have the nationality of a country or territory eligible, in accordance with the contract., The Contractor or a Subcontractor and their respective personnel and affiliates shall be deemed to have the nationality of a country if it is a citizen or constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of that country.

"All Equipment, Materials, Plant and any services to be incorporate in or required for the Works shall have their origin in Eligible Countries.

	"For the purpose of this Sub-Clause 4.1, "origin" means the place where the Equipment, Materials or Plant have been mined, grown, cultivated, produced, manufactured, or processed; or through manufacture, processing, or assembly, another commercially recognized article results that differs substantially in its basic characteristics, purposes or utility from its underlying components. With respect to any services, the term "origin" means the place from which the services are supplied."
	"The contractor shall permit, and shall cause its subcontractors and consultants to permit, the employer and/or persons authorized by the employer to inspect the contractor's offices and all accounts and records relating to the performance of the contract and the submission of the bid, and to have such accounts and records audited by auditors appointed by the employer if requested by the employer."
Sub-Clause 4.2 Performance Security	❖ Name the existing text as Sub-Clause 4.2 (i) ❖ Amend Sub-Clause 4.2 (i) by adding the following at the end: "Without limitation to the other provisions of this Sub-Clause 4.2, whenever the Engineer determines an addition to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor, at the Engineer's written request, shall promptly increase the value of the Performance Security in the applicable currency by an equal percentage. "The Performance Security of a joint venture shall be issued so as to commit fully all members of the joint venture or other consortium. The performance security shall be in the form of a bank guarantee, issued by a bank located in the country of the Employer. The performance security shall be denominated in the types and proportions of currencies in which the Contract Price is payable The cost of complying with the requirements of this clause shall be borne by the contractor
Sub-Clause 4.3 Contractor's Representative	Amend Sub-Clause 4.3 by adding the following at the end: "If the Engineer determines that the Contractor's Representative or any of these persons are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."
Sub-Clause 4.8 Safety Procedures	Amend Sub-Clause 4.8 by adding the following at the end: "The Contractor shall notify the Engineer and Employer within 48 hours or as soon as reasonably possible after the occurrence of any accident which has resulted in damage or loss of property, disability

	or loss of human life, or which has or which could reasonably be foreseen to have a material impact on the environment and shall submit to the Engineer and Employer no later than 28 days after the occurrence of such an event, a summary report thereof."
Sub-Clause 4.18 Protection of the Environment	Amend Sub-Clause 4.18 by adding the following at the end: "The Contractor shall be responsible for ensuring that all Subcontractor's and Contractor's Personnel understand and operate in accordance with the principles and requirements of the environmental and social impacts provisions of this Sub-Clause. "The Contractor's program shall demonstrate clearly the procedures and methods of working that the Contractor and its Subcontractors will adopt to comply with the environmental and social impacts requirements of this Sub-Clause. "The Contractor shall ensure the adequate disposal of construction and excavation wastes. "The Contractor shall restore the Site to original conditions or to a state as set out in the Employer's Requirements after the completion of the Works."
Sub-Clause 4.21 Progress Reports	Amend Sub-Clause 4.21 by adding the following at the end: "The progress report shall also comprise the following: - 1. Payments schedule, planned and actual; 2. No of workers on site and Factory for this project. 3. List of all accidents which have occurred at site during the month; 4. Contract Drawings Status Schedule; 5. Change Order and Variation to contract Status Schedule; 6. Major items that could have an impact on cost or Schedule; 7. Summary of claims issued by the Contractor; 8. Any major problem encountered and remedial solutions proposed."

5. Design

Sub-Clause 5.4 Technical Standards and Regulations	Add the following sentence to the end of the Sub-Clause 5.4: "In respect of technical specifications and standards, any national or international standards which promise to confer equal or better

quality than the standards specified will also be acceptable."

6. Staff and Labor

Sub-Clause 6.4 [Labour Laws]

To add at the end of this sub-clause:

Notwithstanding the above provisions and any other provisions under Part I, the employer and the contractor shall comply with the following:

1.1 (a) The rates of remuneration and other conditions of work of the employees of the Contractor shall not be less favourable than those established for work of the same character in the trade concerned-

(i) by collective agreement applying to a substantial proportion of the workers and employers in the trade concerned;

(ii) by arbitration awards; or

(iii) by Remuneration Regulations made under the Employment Relation Act 2008.

(b) Where remuneration and conditions of work are not regulated in a manner referred to at (a) above, the rates of the remuneration and other conditions of work which are not less favourable than the general level observed in the trade in which the contractor is engaged by employers whose general circumstances are similar.

1.2 No contractor shall be entitled to any payment in respect of work performed in the execution of the contract unless he has, together with his claim for payment, filed a certificate:

(a) stating the rates of remuneration and hours of work of the various categories of employees employed in the execution of the contracts;

(b) stating whether any remuneration payable in respect of work done is due;

(c) containing such other information as the authorized officer administering the contract may require to satisfy himself that the provisions under this clause have been complied with.

1.3 Where the authorized officer is satisfied that remuneration is still due to an employee employed under this contract at the time the claim for payment is filed, he may, unless the remuneration is sooner paid by the Contractor, arrange for the payment of the remuneration out of the money payable under this contract.

1.4 Every contractor shall display a copy of this clause of the contract at the place at which the work required by the contract

	is performed.
Sub-Clause 6.8 Contractor's Superintendence	Amend Sub-Clause 6.8 by adding the following at the end: "If the Engineer determines that the Contractor's Personnel providing superintendence have inadequate knowledge of such language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."
Sub-Clause 6.12 Foreign Personnel	Add the following Sub-Clause 6.12: "The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. 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. "The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial."
Sub-Clause 6.13 Prohibition of Harmful Child Labor	Add the following Sub-Clause 6.13: "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."
Sub-Clause 6.14 Employment Records of Workers	Add the following Sub-Clause 6.14: "The Contractor shall keep complete and accurate records of the employment of labor at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer, and these records shall be available for inspection by auditors during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [*Records of Contractor's Personnel and Equipment*]."
Sub-Clause 6.15 Measures against Insect & Pest Nuisance	The Contractor shall at all times take the necessary precautions to protect all staff and labour employed on the Site from insect and pest nuisance, and to reduce the dangers to health and the general nuisance occasioned by the same. The Contractor shall provide its staff and labour with suitable prophylactics for the prevention of malaria and take steps to prevent the formation of stagnant pools of water. The Contractor shall comply with all the regulations of the

	local health authorities and shall arrange to spray thoroughly with approved insecticide all buildings erected on the Site. Such treatment shall be carried out at least once a year or as instructed by such authorities."
Sub-Clause 6.16 Epidemics	In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing and overcoming the same."
Sub-Clause 6.17 Alcoholic Liquors or Drug	"The Contractor shall not, otherwise than in accordance with the statutes, ordinances and government regulations or orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his Subcontractors, agents staff or labour."
Sub-Clause 6.18 Arms and Ammunition	"The contractor shall not give, barter or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer to the same as aforesaid."
Sub-Clause 6.19 Festivals and Religious Customs	The Contractor shall in all dealings with his staff and labour have due regard to all recognized festivals, days of rest and religious or other customs."

7. Plant, Materials and Workmanship

Sub-Clause 7.7 Ownership of Plant and Materials	Add the following sub-clause after sub-clause 7.8 (a) Any materials, equipment, services or design services which will be incorporated in or required for the Contract, as well as the Contractor's Equipment and other supplies, shall have their origin in eligible source countries. (b) For the purpose of this clause, "services" means the works and all project-related services including design services. (c) For the purposes of this clause, "origin" means the place where the materials and equipment were mined, grown, produced, or manufactured, or from which the services are provided. (d) The origin of Goods and Services is distinct from the nationality of the Supplier."

8. Commencement, Delays and Suspension

Sub-clause 8.4 Extension of Time for completion	Replace paragraph (c) as follows – (c) exceptionally adverse climatic conditions, defined as any one of the following events (1) Minimum of 100mm rainfall recorded in one day at the nearest rain station, (2) An official declaration of "Torrential rain" by the Meteorological Department of Mauritius, and (3) Cyclone warning class III or Class IV
Sub-Clause 8.12 Resumption of Work	Amend Sub-Clause 8.12 by inserting the following at the end: "after receiving from the Engineer an instruction to this effect under Clause 13 [*Variations and Adjustments*]."

11. Defects Liability

Sub-Clause 11.3 Extension of Defects Notification Period	Amend Sub-Clause 11.3 by inserting the following at the end of the first sentence of the first paragraph: "attributable to the Contractor."

13. Variations and Adjustments

Sub-Clause 13.1 Right to Vary	Amend Sub-Clause 13.1 by deleting the word "or" at the end of clause (ii) in the second paragraph and by inserting the following at the end of the first sentence of the second paragraph: "or (iv) such Variation triggers a substantial change in the sequence or progress of the Works."
Sub-Clause 13.7 Adjustments for Changes in Legislation	Amend Sub-Clause 13.7 by adding the following at the end: "Notwithstanding the foregoing, the Contractor shall not be entitled to such an extension of time if the same shall already have been taken into account in determining an extension and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of Sub-Clause 13.8 [*Adjustments for Changes in Cost*]."
Sub-Clause 13.8 Adjustments for Changes in Cost	Amend Sub-Clause 13.8 by inserting the following after the first sentence of the second paragraph: "Adjustment shall be made for the first time during the term of the Contract at the end of month **[insert number of months into the Contract]**, and **[insert frequency]** thereafter."

14. Contract Price and Adjustment

Sub-Clause 14.1
The Contract Price

Amend Subpara. (b) of Sub-Clause 14.1 by deleting the phrase "except as stated in Sub-Clause 13.7 [*Adjustments for Changes in Legislation*]".

[If payment for any part of the Works is to be made on the basis of measurement, that part of the Works must be defined in the Contract and the following wording added.]

Amend Sub-Clause 14.1 by adding the following at the end:

"The Engineer shall agree or determine the value of those parts of the Works which are to be measured, in accordance with Sub-Clause 3.5 [*Determinations*]. Measurement shall be made of the net actual quantities of those parts.

"Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and
(b) supply any particulars requested by the Engineer.

"If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.

"Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured by records, they shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend to examine and agree these records, they shall be accepted as accurate.

"If the Contractor examines and disagrees with the records, and/or does not sign them as agreed, then the Contractor shall notify the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so notify the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate."

Sub-Clause 14.2
Advance Payment

Amend Sub-Clause 14.2 by deleting the phrase ", as an interest-free loan" from the first sentence of the first paragraph.

Amend Sub-Clause 14.2 by replacing the fifth paragraph with the following:

"Unless stated otherwise in the Appendix to Bid, the advance payment shall be repaid through percentage deductions from the interim payments certified by the Engineer in accordance with Sub-Clause 14.6 [*Issue of Interim Payment Certificates*], as follows:

(a) deductions shall commence in the next Interim Payment Certificate following that in which the total of all interim payments (excluding the advance payment and deductions and repayments of retention) certified to the Contractor has reached the percentage of the Accepted Contract Amount stipulated in the Appendix to Bid less Provisional Sums; and

(b) deductions shall be made at the amortization rate stated in the Appendix to Bid of the amount of each Interim Payment Certificate (excluding the advance payment and deductions for its repayments as well as deductions for retention money) in the currencies and proportions of the advance payment until such time as the advance payment has been repaid; always provided that the advance payment shall be completely repaid prior to the time when the percentage of the Accepted Contract Amount less Provisional Sums stipulated in the Appendix to Bid has been certified for payment."

Amend Sub-Clause 14.2 by inserting the following after "become due" in the final sentence:

"and in the case of termination under Clause 15 [*Termination by Employer*] or Sub-Clause 19.6 [*Optional Termination, Payment and Release*], "

Sub-Clause 14.7
Payment

Amend Sub-Clause 14.7 by replacing the first line with the following:

"The Employer shall pay or cause to be paid to the Contractor:"

Sub-Clause 14.8
Delayed Payment

Amend Sub-Clause 14.8 by replacing the second paragraph with the following:

"These financing charges shall be calculated at the annual rates of interest and shall be paid in the currencies indicated in the Appendix to Bid."

Sub-Clause 14.9
Payment of Retention Money

Amend Sub-Clause 14.9 as follows:

"When the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified by the Engineer for payment, the Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions or in another form approved by the Employer and provided by an entity approved by the Employer, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security in Sub-Clause 4.2 [*Performance Security*]. On receipt by the Employer of such guarantee, the Engineer shall certify

and the Employer shall pay, or cause to be paid, the second half of the Retention Money. The release of the second half of the Retention Money against such guarantee shall then be in lieu of the release under the second paragraph of this Sub-Clause. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate.

"If the Performance Security required under Sub-Clause 4.2 [*Performance Security*] is in the form of a demand guarantee, and the amount guaranteed under it when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security."

Sub-Clause 14.11
Application for Final Payment Certificate

Amend Sub-Clause 14.11 by inserting the following in the first sentence of the second paragraph after "may reasonably require":

"within 28 days *from request of the Engineer*'"

15. Termination by Employer

Sub-Clause 15.6
Corrupt or Fraudulent Practices

Add the following Sub-Clause 15.6:

It is the policy of the Government of the Republic of Mauritius to require Public Bodies, as well as bidders, suppliers, and contractors and their agents (whether declared or not), personnel, subcontractors, sub-consultants, service providers and suppliers, observe the highest standard of ethics during the procurement and execution of contracts. [14] In pursuance of this policy, the Government of the Republic of Mauritius:

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

(i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[15];

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

[14] In this context, any action taken by a bidder, supplier, contractor, or any of its personnel, agents, sub-consultants, sub-contractors, service providers, suppliers and/or their employees to influence the procurement process or contract execution for undue advantage is improper.

[15] "Another party" refers to a public official acting in relation to the procurement process or contract execution. In this context, "public official" includes employer's staff and employees of other organizations taking or reviewing procurement decisions.

to obtain a financial or other benefit or to avoid an obligation; [16]

(iii) "collusive practice" is an arrangement between two or more parties[17] designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party[18] or the property of the party to influence improperly the actions of a party;

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede the Employer's investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or

(bb) acts intended to materially impede the exercise of the employer's inspection and audit rights provided for under sub-clause 4.1 Part II of the contract.

(a) will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question; and

(b) will sanction a firm or an individual, at any time, in accordance with prevailing legislations, including by publicly declaring such firm or individual ineligible, for a stated period of time: (i) to be awarded a public contract; and (ii) to be a nominated[b] sub-contractor, consultant, manufacturer or supplier, or service provider of an otherwise eligible firm

[16] "Party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

[17] "Parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, noncompetitive levels.

[18] "Party" refers to a participant in the procurement process or contract execution.

[b] A nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding document) is one which either has been: (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that are accounted for in the evaluation of the bidder's pre-qualification application or the bid; or (ii) appointed by the Employer.

being awarded a public contract.

(c) The Contractor shall take steps to ensure that no person acting for it or on its behalf will engage in any type of fraud and corruption during the contract execution.

Transgression of the above is a serious offence and appropriate actions will be taken against such contractor.

16. Suspension and Termination by Contractor

Sub-Clause 16.2
Termination by Contractor

Amend Subpara. (d) of Sub-Clause 16.2 by adding the following at the end:

"in such manner as to materially and adversely affect the economic balance of the Contract and/or the ability of the Contractor to perform the Contract,"

Amend Subpara. (f) of Sub-Clause 16.2 by deleting the word "or" at the end.

Amend Subpara, (g) of Sub-Clause 16.2 by replacing the period at the end with "; or".

Amend Sub-Clause 16.2 by adding the following at the end of the first paragraph:

"(h) the Contractor does not receive the Engineer's instruction recording the agreement of both Parties on the fulfillment of the conditions for the commencement of Works under Sub-Clause 8.1 [*Commencement of Works*]."

17. Risk and Responsibility

Sub-Clause 17.3
Employer's Risks

Amend Sub-Clause 17.3 by replacing the first line with the following:

"The Employer's risks, insofar as they directly affect the design and execution of the Works,"

Sub-Clause 17.6
Limitation of Liability

Amend Sub-Clause 17.6 by replacing the first paragraph with the following:

"Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, other than as specifically provided in Sub-Clause 8.7 [*Delay Damages*]; Sub-Clause 11.2 [*Cost of Remedying Defects*]; Sub-Clause 15.4 [*Payment after Termination*]; Sub-Clause 16.4 [*Payment on Termination*]; Sub-Clause 17.1 [*Indemnities*]; Sub-Clause 17.4 (b) [*Consequences of Employer's Risks*] and Sub-Clause 17.5 [*Intellectual and Industrial Property Rights*]."

18. Insurance

Sub-Clause 18.1
General Requirements for Insurance

Amend Sub-Clause 18.1 by adding the following at the end:

"The insuring Party shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to in Clause 18 [*Insurance*]) with insurers from any eligible source country unless otherwise stated in the Appendix to Bid."

Sub-Clause 18.5
Insurance for Design

Add the following Sub-Clause 18.5:

"The Contractor shall effect professional indemnity insurance which shall cover the risk of professional negligence in the design of the Works. This insurance shall be for a limit of not less than the amount stated in the Appendix to Bid, with no limit on the number of occurrences. The Contractor shall maintain the professional indemnity insurance in full force and effect until 5 years after the Time for Completion. The Contractor undertakes to notify the Employer promptly of any difficulty in extending, renewing or reinstating this insurance."

19. Force Majeure

Sub-Clause 19.4
Consequences of Force Majeure

Amend Sub-Clause 19.4 by inserting the following at the end of Subpara. (b):

", including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 18.2 [*Insurance for Works and Contractor's Equipment*]."

20. Claims, Disputes and Arbitration

Sub-Clause 20.1
Contractor's Claims

Amend Sub-Clause 20.1 by inserting the following as a new paragraph between subparagraphs 6 and 7:

"Within the above defined period of 42 days, the Engineer shall proceed in accordance with Sub-Clause 3.5 [*Determinations*] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 [*Extension of Time for Completion*], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract."

Amend Sub-Clause 20.1 by deleting paragraph 8 (in the order of paragraphs prior to the amendment made above) and replacing it with the following new paragraph:

"If the Engineer does not respond within the timeframe defined in this Sub-Clause, either Party may consider that the claim is rejected by the Engineer and either Party may refer such claim to the DAB in accordance with Sub-Clause 20.4 [*Obtaining Dispute Adjudication*

	Board's Decision]."
Sub-Clause 20.2 Appointment of the Dispute Adjudication Board	Amend Sub-Clause 20.2 by inserting the following at the end of the first sentence of the second paragraph: ", 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 construction involved in the Works and with the interpretation of contractual documents."
Sub-Clause 20.6 Arbitration	Amend Sub-Clause 20.6 by replacing the first paragraph with the following: "Any dispute not settled amicably and in respect of which the DAB's decision (if any) has not become final and binding shall be finally settled by arbitration. Unless otherwise agreed by both Parties, the dispute shall be referred to the competent court of Mauritius or for Arbitration under Mauritian Laws.

Section 4. Employer's Requirements

Section 4. Employer's Requirements

Notes on Preparing Employer's Requirements

These Notes for preparing Employer's Requirements are intended as a guide for the Employer or the person drafting the bidding documents and should not be included in the final document.

In the traditional approach the Employer employs an Architect/Engineer to design the Works. From this design, a detailed technical specification is drawn up for bidders to bid on.

In a Design-Build or Turnkey approach, the design is to be done by the Contractor. No detailed technical specification as is normally recognized is developed at the pre-bid stage. However, the Employer does and must know what it wants and must communicate its needs to the bidders. Hence, this section on Employer's Requirements replaces the usual Technical Specifications of a more traditional approach.

To enable bidders to submit responsive bids and, subsequently, for the bids received to be evaluated in a fair and equitable manner, the Employer must state its requirements as clearly and as precisely as possible. The Employer's requirements must therefore, specify exactly the particular requirements of the completed Works including scope and quality. Where the performance of the completed Works could be measured in quantitative terms (e.g. production output of a manufacturing plant or maximum generating capacity of a power station) the Employer's Requirements should not only clearly specify the desired output/capacity but also the upper and lower acceptable limits of deviation from the desired capacity and how such deviations (if any) will be evaluated. It will also be necessary to specify the tests that will be carried out on completion of the Works to verify compliance with the requirements specified. The Employer's Requirements should also clearly specify what associated or incidental services and goods must be supplied by the Contractor. For example, the Contractor may be required to train the Employer's personnel and to supply consumable or spare parts as listed in a Schedule.

While this section of the bidding documents should endeavour to define the Employer's Requirements as precisely as possible care must be taken to avoid over specifying details to the extent that the flexibility and potential benefits associated with a Design-Build or Turnkey contract are seriously eroded or threatened. This section on Employer's Requirements should, therefore, be carefully prepared on behalf of the Employer by suitably-qualified professionals who are familiar with the requirements and with the technical aspect of the required Works.

For major and complex projects, the Design-Build or Turnkey Contract will have to be subject to international competitive bidding and the Employer's Requirements must be drawn up to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials and performance of the Works. Only if this is done will the objectives of economy and efficiency and equality in procurement be realized, responsiveness of bids be ensured and the subsequent task of bid evaluation facilitated. The Employer's Requirements should stipulate that all goods and materials to be incorporated in the Works are new, unused, of the most recent or current models and incorporate all recent improvements in design and materials.

Notes on Preparing Employer's Requirements *(continued)*

As for the drafting of Technical Specifications, care must be taken when drafting the Employer's Requirements to ensure that the requirements are not restrictive. In the specification of standards of goods, materials and workmanship recognized international standards should be used as much as possible. Where other particular standards are specified, whether national standards or other standards, it should be stated that goods, materials and workmanship meeting other authoritative standards and which promise to ensure equal or higher quality than the standards specified, will also be acceptable. Where a brand name of a product is specified it should always be qualified with the terms or "equivalent".

In addition to stating the requirements of the completed Works clearly, the Employer Requirements Section should also include matters related to the execution of the Works to enable the bidders to gauge the extent of responsibility and to price the bid accordingly. The matters referred to in some of the following Sub-Clause (FIDIC Part I) may be included:

1.9 Number of copies (and required extent) of Construction Documents.

4.1 Design criteria and calculations (if any) to be checked by the Contractor and confirmed to be correct with the bid.

4.4 Other contractors and organization (and others) on site to whom the Contractor should afford reasonable opportunities for them to carry out their work.

4.7 Setting-out points, lines and levels of reference to be used.

4.8 Quality Assurance system details.

4.12 Access routes particularly if such routes are within existing facilities.

4.13 Periods for preconstruction reviews and for any submission, approvals and consents.

4.20 Employer's machinery and materials.

5.1 Qualification criteria of design personnel.

5.2 Extend and procedures for submission and preconstruction reviews of Construction documents.

5.5 List of samples and procedure for submission for preconstruction testing and review of data.

5.6 Form and number of As-built drawings and records of the works to be submitted and approval process.

5.7 Timing and number of copies of Operation and Maintenance Manuals to be submitted and approval process.

Notes on Preparing Employer's Requirements *(continued)*

6.6 ***Facilities to be provided on site by the Contractor for the Employer and the Employer's Representative and its personnel.***

7.4 ***Tests to be carried out during manufacture and/or construction.***

9.1 ***Tests to be carried out in Completion before Taking-Over to demonstrate completion. If the works are to be tested and taken over in stages, the test requirements and special arrangements must be detailed.***

11.1 ***Test to be carried out after Taking-Over to verify that the Works fulfill the performance requirements.***

11.4 ***Minimum performance criteria acceptable below which works failing to pass tests after completion will be rejected.***

1.0 General Project Requirement and Completion Schedules

The Project comprises of the design, supply, installation, testing, commissioning, start-up, and performance verification of a ground mounted 1MWac PV Farm at Grenade in Rodrigues Island for the Republic of Mauritius to be located as follows:

Rodrigues Island		
Location	**GPS Coordinates**	**Rated Power**
Grenades	(19°41'7.99"S, 63°28'44.50"E)	1MWac

The Solar PV Farm shall have an exporting capacity of 1MWac measured at the new 22kV substation. The required commissioning date for the PV Farm is as follows:

Item N°	**Description**	**Works site**	**Completion Date after issue of Letter of Acceptance**
1	1MWac Solar PV Farm	Grenade	Within 12 months from the Commencement Date

2.0 General Information

2.1 The Republic of Mauritius– The Project Country

The Republic of Mauritius is a group of islands in the South West of the Indian Ocean, consisting of the main island of Mauritius, Rodrigues and some outer islands. Mauritius has been successively a Dutch, French and British Colony. It became independent on 12th March 1968 and acceded to the status of Republic on 12th March 1992. The official language is English, but French is widely spoken. The population is estimated at 1.26 million as at 2017.

Rodrigues Island is a 108 km^2 autonomous outer island of the Republic of Mauritius in the Indian Ocean, about 560 km east of Mauritius.

2.2 Climate

Rodrigues enjoys a mild tropical maritime climate with persistent trade winds blowing throughout the year. Mean summer temperature is 25.9 degrees Celsius and mean winter temperature is around 22.3 degrees Celsius. The temperature difference between summer and winter is 3.6 degrees Celsius. January to March are the hottest months and August is the coolest month. The relative humidity varies from a minimum of 74% during the dry months of September and October; to a maximum of 81% during the wettest month of February. The island receives about 8.9 hours of bright sunshine daily.

2.3 Energy Resources

Rodrigues has no known oil, natural gas or coal reserves, and is therefore heavily dependent on imported energy carriers. In 2017, the country imported some 9946 tons of petroleum products for electricity generation. The balance of input for electricity production is met from petroleum and renewable sources, namely, wind. To date, Rodrigues Island produces about 6.53% of its electricity from renewable resources.

2.4 Long Term Energy Policy 2009-2025

In October 2009, the Government of Mauritius released its Long Term Energy Policy which set the concepts underlying the economic and regulatory framework, established key objectives and action plan for the development of the energy sector in the Republic of Mauritius. The key objectives of the Mauritian energy policy are to:

a) Limit the vulnerability of Mauritius to imported fossil fuels and their volatile prices
b) Promote economic growth and job creation
c) Democratize energy supply
d) Secure affordable energy to consumers
e) Ensure the financial sustainability of the Utility.

One key principle underpinning the Government Policy is to further promote the use of renewable energy in the electricity generation mix with a view to reducing our dependency on imported fossil fuels. It is therefore expected that the Power System would need to accommodate the diverse technologies involved by a changing Generating Mix (diesel, coal-bagasse, hydro, proposed coal, wind, and other renewable sources of electricity) over the forthcoming years. More information on the Energy Policy 2009-2025, is available for viewing on the Ministry of Public Utilities website at http://www.govmu.org/portal/site/mpusite.

2.5 Central Electricity Board

The CEB is a parastatal body wholly owned by the Government of Mauritius, and reports to the Ministry of Public Utilities. Established in 1952 and empowered by the Central Electricity Board Act of 25 January 1964. CEB's business is to 'prepare and carry out development schemes with the general object of promoting, coordinating and improving the generation, transmission, distribution and sale of electricity' in the Republic of Mauritius.

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2.6 Generation

In 2017, the total generated electricity of the island for public consumption reached 42.7 GWh, produced by CEB. The installed capacity of Thermal Power plants is 12.3 MW and Wind Plants is 1.280 MW.

The system peak demand reached 8.052 MW in 2018.

2.7 Rodrigues Power System

The Rodrigues power system consists of 22kV distribution network energized by two thermal power plants at Port Mathurin and Pointe Monnier, and two small sized wind farms at Trefles and Grenade. A 22 kV line, which forms part of the Cotton Bay Feeder originating from Port Mathurin substation, is present on the site and interconnects the Wind Plants. This 22 kV line shall be used to evacuate power for the 1MWac PV farm. Ultimately, extension of Port Mathurin feeder from Port Mathurin substation shall be used for power evacuation. The new 22kV line will be extended from Grand bay up to Grenade.

The power system consists of six 22kV Feeders, namely Cotton Bay, Port Mathurin, Malartic, Oyster Bay, Ti Reserve and Queen Elizabeth Hospital which are extended in radial configuration from the two 22kV Substations.

2.8 Power System Analysis Software

The CEB owns and uses the DIgSILENT Powerfactory software for system planning purposes. The main software functionalities cover load flow analysis, fault analysis, protection analysis and transient stability analysis. In addition the available network model

and database of the CEB's grid cover the dynamic models of prime movers, governor control system and automatic voltage control system requires for stability studies.

3.0 General Description of Work

3.1 General

The CEB (hereinafter referred to as the "Employer") intends to set up a Solar PV Farm with an AC power output of 1MWac measured at new 22kV indoor switchgear substation in CEB's Grenade, referred to as the Point of Common Coupling (PCC) . The solar PV farm is to be located at Grenade (hereinafter referred to as the "Project"). The Project shall comprise of the design, supply, construction, testing, commissioning of a solar PV farm to be connected to the CEB network.

This Solar PV Farm, once operational, is expected to generate more than 1.6 GWh annually and shall contribute in meeting the Government objective to reduce our dependency on fossil fuel.

The generated power from the solar PV farm will be evacuated onto two 22kV feeders namely Cotton Bay and Port Mathurin. 400 kWac on Cotton Bay Feeder and 600kWac on Port Mathurin Feeder. However, it is to be noted the Port Mathurin Feeder may accommodate 1 MWac generated power.

The Employer shall make available the site to the successful bidder (hereinafter referred to as the "Contractor") and be responsible to secure the EIA license and all other related permits including the Building and Land Use Permit (BLUP).

For Award of BLUP, the following shall be part of the scope of works:

(1) Structural drawings submitted by the Contractor shall be signed by a Civil Engineer registered with the Council of Registered Professional Engineers Mauritius.

(2) Architectural drawings submitted by the Contractor shall be signed by a registered professional Architect based in Mauritius.

Note: All drawings required as per the BLUP guide provided in (Section 8 – Drawings and Other Documents) for application and receipt of the BLUP shall be submitted by the Contractor within four (4) weeks from the commencement date. If the Contractor does not fulfil this requirement, the Contractor will be fully responsible for the additional delay to obtain the BLUP & of the associated delay resulting in postponement of the beginning of the Works in site.

- The Contractor shall clearly take into consideration and indicate inside its planning :
    - The milestone "BLUP application", 4 weeks after the commencement date;
    - The milestone "BLUP receipt", 6 weeks after the milestone "BLUP application".

3.2 Site Location

The Grenade site is located within that area as shown in guide drawing **S-5191.** The plot of land earmarked for this project is demarcated by the contour lines in the drawing earmarked above.

3.2.1 Delivery to Site

Port Mathurin in Rodrigues has a quay at which material can be unloaded alongside the ship's lifting machinery. From Port Mathurin there is an asphalted road up to the site vicinity at Roche Bon Dieu. From the main asphalted road at Roche Bon Dieu there is about 500 metres of track road up to the site at Grenade.

The Contractor shall make his own arrangements for, and bear all expenses in connection with the importation, unloading and transport to Grenade site of all plants and materials needed for the purpose of the contract including installation and commissioning. All materials will be unloaded at Port Mathurin, Rodrigues.

3.3 Climate – Meteorological Data

Months	Temperature				U	Wind	Sunshine	Rainfall	Count	Count
	Av mx	Hi mx	Av mn	Lo mn	%	km/h	hrs/day	LTM1981-200	RR>1.0	RR>5.0
Jan	29.2	33.9	23.6	18.4	79	19.3	8.9	149	12	5
Feb	29.3	34.0	23.8	19.8	81	19.3	8.5	160	13	7
Mar	29.4	33.9	23.7	19.0	80	17.4	8.3	133	13	6
Apr	28.7	33.0	23.0	18.4	79	17.4	8.1	138	13	5
May	27.5	30.9	21.6	18.1	75	16.9	7.9	84	12	4
Jun	26.0	30.9	20.1	16.5	74	17.0	7.3	72	13	5
Jul	25.0	30.4	19.1	14.5	75	19.3	7.5	87	15	4
Aug	24.8	31.2	18.8	15.2	74	19.6	7.9	63	13	3
Sep	25.4	30.7	19.3	15.8	74	18.7	7.9	51	9	3
Oct	26.3	30.9	20.1	16.5	74	18.3	8.9	43	8	2
Nov	27.4	30.9	21.3	17.2	76	17.4	9.1	64	7	3
Dec	28.7	33.1	22.8	19.2	77	17.2	9.2	58	8	2

The island receives about 8.9 hours of bright sunshine daily and the average wind speed on any day is 18.1 km/h at Pointe Canon.

Note: Av mx: Average maximum in degrees Celsius
Hi mx: Highest maximum in degrees Celsius
Av mn: Average minimum in degrees Celsius
Lo mn: Lowest minimum in degrees Celsius
U: Relative humidity
LTM: Long term mean
RR: rainfall

Rodrigues enjoys a mild tropical maritime climate with persistent trade winds blowing throughout the year. Mean summer temperature is 25.9 degrees Celsius and mean winter temperature is around 22.3 degrees Celsius. The temperature difference between summer and

winter is 3.6 degrees Celsius. January to March are the hottest months and August is the coolest month.

The relative humidity varies from a minimum of 74% during the dry months of September and October; to a maximum of 81% during the wettest month of February. The island receives about 8.9 hours of bright sunshine daily.

3.4 Extent of Works

The Contract covers the design, supply, construction, manufacture, testing, insurance, packaging for export, shipping, transport, delivery to site, unloading at site, equipment erection, commissioning and putting in normal operation, performance testing on completion, training and instruction to Employer's personnel and making good of any defects and warrantying the whole installation up to the end of the defect liability period.

3.5 Contractor`S Responsibility

While every effort will be made by Employer to assist the Contractor in obtaining full and accurate information, the Contractor shall be fully and unrestrictedly responsible for the design of the Works. The Contractor shall carry out a detailed evaluation of the site and of local conditions, and shall prepare detailed designs conforming to the requirements of this tender and of any amendments thereto.

The Employer shall allow the Contractor to have access to the available drawings and documentation relating to the site. The Contractor shall check and verify any information taken from these drawings and documents for use in the design of the Works and shall be responsible for its accuracy.

The Contractor shall **not** be relieved of his obligations under the Contract by any inaccuracy or deficiency in these drawings or documentation, or by the unavailability of any particular drawing or document.

3.6 Responsibility For Adequacy Of Existing Systems

The Contractor shall be deemed to have satisfied himself before preparing his proposal of the suitability and adequacy of the existing facilities and equipment. This will apply in particular where the correct operation of the new equipment depends on the existing facilities and equipment. If it is found that the existing facilities or equipment are unsuitable or inadequate, the Contractor shall advise CEB of this **in good time** and make **all** necessary modifications with the **approval** of the CEB.

3.7 Project Site Layout

The Contractor shall prepare a detailed site layout and shall include the following:

1. Area map indicating development location and orientations, including local coordinates and site boundaries
2. Local view (Google map image) indicating solar PV farm installation and orientations;
3. Topography, major roads, existing distribution lines, substation adjacent structures, existing paved roads, existing gravel/dirt roads, as well as other feature such as lakes, rivers and creeks among others;
4. The Contractor shall also submit detailed layouts of the proposed solar PV farm including the elements mentioned hereunder:

    a) Solar PV Array Field
    b) Internal Roads
    c) Cable trenches and draw pits including support details
    d) Switchgear, Control, Electrical rooms and Store among others.
    e) Communication Systems and associated equipment for remote control and monitoring at Port Mathurin.
    f) Two Solar Compact Stations comprising of step up Transformers, UPS and AC panels among others.
    g) Lightning protection and earthing system
    h) Electrical metering points
    i) Entrance road(s)
    j) Construction staging and laydown area(s) and footprints
    k) Site perimeter dimensions
    l) Appropriate Drainage System
    m) Any other drawings as may be requested by the Employer

5. The following identified drawings, shall also be submitted:

    a) Detail structural drawings for all buildings planned in the PV Farm.
    b) Detailed view of the proposed sub-array (i.e. the portion of the PV array feeding a single inverter)
    c) Detailed top view of the proposed PV mounting system (including module dimensions, and row-to-row spacing).
    d) Detailed side and/or front view of the proposed PV mounting system and footer. Include dimensions of height, depth of penetration, and method for installing ground posts.
    e) All buildings and rooms floor plan and elevations.
    f) Cross-section of electrical trench for wiring from combiner boxes to inverter building.
    g) Transformer cabin Floor Plan and detailed view of their bases
    h) Elevation of fencing.
    i) Any other drawings as may be requested by the Employer.

6. The above drawings will have to be submitted to the Employer within 4 weeks from the Commencement Date for application for Building and Land Use Permit (BLUP).

3.8 Electrical Studies

The Contractor shall perform all necessary studies and detailed design drawings to confirm equipment characteristics and to enable orderly and expeditious procurement, construction and ultimately installation and commissioning on site. The Electrical studies shall include but not be limited to the following;

1. Photovoltaic Equipment sizing to meet the requirement of this tender.
2. Inverter Sizing to meet the requirement of this tender
3. Cables Sizing;
4. Transformer sizing.
5. UPS Sizing.
6. Short circuit calculation as per IEC 60909 to determine the choice of equipment and materials to be used.
7. Earthing system studies as per IEEE 80, to calculate touch and step potentials for the site, to achieve an earth grid with touch and step potentials within safe limits.
8. Protection Studies for the LV and MV systems for the Point of Common Coupling of the PV Farm of the (Taking into consideration the protection philosophy of CEB and transformer vector group);
9. Interlocking and inter tripping scheme for safe operation of the system.Any other studies deemed necessary to determine the choice of the different equipment and materials.
10. All studies and calculations shall be submitted by the Contractor for review and approval by the Employer prior to manufacturing, ordering and installation. The Employer reserves the right to request the Contractor to carry out additional studies prior to ordering.

3.9 Underground Obstruction

The Contractor's attention is drawn to the underground obstructions which may exist on each site. These obstructions will have to be removed only where they lie within the volumes of material to be removed, to the extent required to achieve the general new ground levels.

The position and extent of all structures left in shall be recorded and records shall be submitted to the CEB.

The Contractor shall make his own interpretations from the information provided to him by CEB and from his inspection of the Site, and shall be deemed to have taken account of this information in the preparation of his Tender. All storm water drains on the site must be diverted to ensure smooth drainage. No directly buried or in pipe underground cables shall be relocated unless approved by the Employer.

3.10 Use of Site

The Contractor should use the Site only for purposes connected with the Contract

3.11 Security of Site

The Contractor shall ensure that access by unauthorized persons to his working area is prevented at all time during the contract period,

The Contractor shall provide protection to safeguard the materials, stores and any installations on the site. The Employer will not accept responsibility for any delay, loss or damage to materials or equipment which may occur during the execution of the contract. The use of unsupervised guard dogs shall not be permitted.

3.12 Manufacturer Instruction

The Contractor shall supply to CEB two copies of the current manufacturer's instructions and explanatory brochures for all propriety civil and building works materials or processes to be used in the Contract prior to their incorporation in the works.

3.13 Privately and Publicly Owned Services

The Contractor shall make his own enquiries, where required, of the Service Authorities and satisfy himself as to the exact position of their apparatus and the depth, size and gradient thereof. The Employer will provide the necessary assistance.

Where any privately owned service for water, electricity, drainage, etc. passing through the Site is affected by the Works, the Contractor shall locate it and with the agreement of the owner provide a satisfactory alternative service before cutting the existing service.

The Contractor shall be responsible for making arrangements with the Service Authorities concerned, for the phasing into his Program of Works of all operations which need to be executed by them or their contractors, concurrently with the Works.

The Contractor shall be responsible for coordinating and integrating all Service Authorities' work so that each may proceed in such a manner as to ensure proper performance and to avoid conflict between them. He shall arrange for the Service Authorities concerned to attend co-ordination meetings.

The Contractor shall take any and all measures reasonably required by any Service Authority, for the support and full protection of its mains, pipes, cables and other apparatus during the progress of the Works, and shall construct and provide, to the satisfaction of the Service Authority concerned, all works necessary for the prevention of damage or interruption of services. If, in the execution of the Works, the Contractor causes either directly or indirectly, any damage to any apparatus or any interruption of any service, the Contractor shall bear and

pay the cost incurred by the Service Authority for any loss sustained as a result of such damage or interruption.

The Contractor shall, at all times during the progress of the Works, afford facilities to properly accredited agents of any Service Authority for access to any of their apparatus situated in or under the Site, as may be necessary for inspecting, reporting, maintaining, removing, renewing or altering such apparatus in connection with the construction of the Works or for any other purpose whatsoever.

Where any temporary stoppage, diversion, or reinstatement of any existing services is required by the Contractor, he shall make his own arrangements with the owners of the service and with all other persons affected by such work. He shall rectify any damage caused and shall relieve the Service Authority of all claims in respect of any loss or interruption involved.

When locating existing services on Site, the Contractor shall search, by safe methods which will not endanger the service or others, to determine its precise position. Trial holes shall be dug where necessary and in accordance with the appropriate Service Authority's requirements to locate services before works are commenced in each area.

All work carried out by the Contractor or adjacent to any apparatus owned by any Service Authority shall comply with the Service Authorities' requirements.

If any underground service is encountered unexpectedly, excavation shall cease and the Employer shall be notified immediately. Emergency measures, as necessary, shall be put in hand without delay and without prejudice to the indemnity of the Service Authority.
Disused services found within the Works shall be notified to the Employer. The Contractor shall obtain confirmation from the owner of such service whether it is abandoned, or whether the owner wishes to recover the service. Upon notification that any service is abandoned, it shall become the property of the Contractor, who shall notify the Employer immediately.

3.14 Working Hours

The Contractor shall comply with all of the provisions of the Mauritian Labour Act. No other restriction will be placed by the Employer on the hours worked by the Contractor.

It will be the responsibility of the Contractor to ensure that any work carried out during unsocial hours does not cause a nuisance.

In giving his consent the Employer shall impose such conditions as he considers reasonable to reduce the nuisance and notwithstanding the issuing of any such consent, the Contractor shall comply at all times with the noise limitations and the control of dust limitations laid down in Sections 3.20 and 3.30 respectively.

The Contractor is to bear all costs in respect of overtime shift and night-work allowances.

3.15 Meetings

The Contractor shall attend progress meetings as may be required by the Employer during the contract period. A contract meeting shall be held every four weeks during the contract period commencing with a kick-off meeting not more than four weeks after the date of the Letter of Acceptance. Meetings will normally be held at the Employer's Office and each party will carry their own cost for travel, board and lodging when participating in meetings.

During the course of the site erection works, weekly site meetings shall be held between the Employer and Contractor.

Safety meetings shall be held as part of the weekly site meetings.

3.16 Ordering and Records of Goods and Materials

Whenever required by the Employer, the Contractor shall supply two copies of orders for goods and materials at the time when such orders are placed complete with expected time of arrival on site. This requirement shall apply both to orders placed directly by the Contractor and to orders placed by a supplier or sub-contractor for the execution of a sub-contract.

Commercial information such as prices may be excluded.

The Contractor shall maintain a detailed record of all materials received on the Site or in his stores or storage and working areas in the vicinity of the Site and shall make such records available to the Employer at such times as the former may reasonably require.

3.17 Subcontracting

Where the Contractor proposes to subcontract any part of the Works, the Employer will require the Contractor to demonstrate that such subcontracting will not interfere with the Contractor's control of the Works.

As soon as practicable after entering into the Contract, the Contractor shall enter into the subcontracts which he considers necessary for the satisfactory and timely completion of the Works.

All sub-orders, and subcontractors and vendors' drawings, shall contain the following reference:

Central Electricity Board, Mauritius
1MWac PV Farm
Grenade, Rodrigues Island

All sub-orders shall be in the English language.

3.18 Datum

All levels used for the construction of the Works shall be referred to a benchmark agreed with the Employer.

3.19 Setting Out

The Contractor shall agree with the Employer and shall provide such bench marks and setting out points, in a form approved by the Employer and as are necessary for the correct setting out and control of levels for the Works
The Contractor shall thereafter in accordance with set out the Works. The Contractor shall, as the work proceeds, supply the Employer with records in an approved form relating to all reference pegs and Works bench marks and shall regularly keep such records up to date by formal notice to the Employer.

Where setting out markers are likely to be disturbed during the progress of the works the Contractor shall transfer such markers to an adjacent point which will not be disturbed. The Employer shall be immediately informed of such changes, including subsequent re-establishment of these markers, and given full details of the relative position of the points.

The setting out of the Site boundaries shall be agreed by the Employer before Site clearance commences and the Contractor shall set out the line and level of any sections of the Works as required by the Service Authorities to enable them to carry out temporary or permanent alterations.

The Contractor shall set out portions of the work at such times as may be necessary to enable Service Authorities to carry out temporary or permanent alterations to their mains, services and apparatus.

The Employer will be required to check the Contractor's setting out of all lines, levels and dimensions described for the execution of the Permanent Works and in relation to all measurements made in relation thereto. For this purpose, the Contractor shall make available for the use of the Employer, at such times and places as the Employer may direct, such staffs, ranging rods, pegs, measuring tapes and chainmen as the Employer may reasonably require.

3.20 Site Condition and Access

The Contractor shall maintain all roads and associated structures to at least the standard at the beginning of the Contract, and for this purpose, the Contractor shall take photographs at a maximum of 30 meters intervals along the road in the presence of the Employer prior to the work commencing. Two copies of these photographs, clearly identifying the location of each photograph and showing the whole of the road surface, shall be lodged with the Employer and will be used to demonstrate any subsequent deterioration of the road surface.

The Contractor shall construct all temporary roads and tracks to his working area and maintain them to the satisfaction of the Employer.

3.21 Precautions to Prevent Nuisance and Noise

The Contractor shall use all reasonable means to prevent or reduce noise and prevent nuisance arising as a result of the Works. This obligation shall extend to all operations necessary to transport all equipment and materials to and from the Site and to dispose of all waste material.

The Contractor shall comply with the general recommendations set out in BS 5228 Code of Practice for Noise Control on Construction and Demolition sites together with the requirements described below.

Without prejudice to the generality of the Contractor's obligations under the preceding paragraph, the Contractor shall comply in particular with the following requirements:

All vehicles and mechanical plant used for the purpose of the Works and the Transport of materials shall be fitted with effective exhaust silencers and shall be maintained in good and efficient working order. Road vehicles shall be maintained to the standards required by the Road Vehicles (Construction and Use) Regulations 1986 and all subsequent amendments thereto.

Where "out of hours" working is permitted, noise levels measured 1 meter from the facade of any residential property shall not exceed the existing background noise level.

3.22 Transport to Site and Existing Roads and Bridges

The Contractor shall be responsible for the importation, offloading and transport to the Site of all plant, material and equipment needed for the purposes of the execution of the Contract including all costs, expenses and other charges.

The Contractor shall be responsible for providing all necessary means of access to the Site and all temporary roads within the Site.

The Contractor shall also ascertain that the vehicles, wagons and loads that he intends to use will not damage, in any way, any roads, bridges, footpaths, etc. The Contractor shall indemnify the Employer in respect of the transport and deposition of the excavated material from the site and any required filling imported to the site.

3.23 Parking of Motor Vehicles

Motor vehicles used by the Contractor or his employees shall be parked in such a way that it does not obstruct traffic flow. The Contractor may make arrangements with adjoining landowners for the parking of these vehicles, but any such arrangement shall be at the Contractor's own risk and to the Contractor's own cost.

3.24 Temporary Dwellings

The Contractor shall not provide or permit any caravans or other temporary dwelling accommodation on the Site.

3.25 Temporary Site Services

3.25.1 Site Electricity Supply

The Contractor shall make all arrangements for any temporary electricity supply that he may require for the execution of the Works; he shall issue any notices and pay all fees, dues, charges and other costs incurred thereby.

The Contractor shall be responsible for providing and maintaining the whole of the installation on the load side of the points of supply, and in relation thereto shall take all reasonable precautions to ensure the safety of every person on the Site.

The Employer may require the disconnection or alteration of any parts which he considers may be dangerous. In such cases the Contractor shall pay the cost of making the apparatus safe.

The design, location, utilization and maintenance of the installation must be in accordance with the latest edition of Mauritian Standard MS 63; "Code of Practice for Electrical Installation in Buildings", and must receive approval of the Engineer or his authorized representative. All local Electricity Regulations and Ordinances shall be strictly observed.

All portable lights must be of low voltage and for this purpose the Contractor is to provide his own transformers with centre point earthing.

The Contractor shall undertake not to remove any of the installations until such time as instructed to do so by the Employer.

3.25.2 Water Supply

The Contractor shall make his own arrangements for a suitable and adequate supply of water to cover all requirements in connection with the execution of the Works and he shall issue all notices and pay all fees, dues, charges and other costs incurred thereby.

The Contractor will be required to supply water for construction and also for drinking purposes.

3.26 Notices of Operations

No important operation shall be commenced without the consent in writing to the Employer, and without full and complete notice also in writing being given to the CEB sufficiently in

advance of the time of the operation so as to enable him to make such arrangements as he may deem necessary for its inspection.

3.27 Proposals For Methods Of Works

The Contractor shall submit information pertaining to methods of **all Works** to be carried out prior to start of work. Such information shall be submitted in good time so that the CEB shall have **at least fourteen (14) full working days** from receipt of this information to consider the Contractor's proposals before the commencement of any works, or in the event that in the opinion of the CEB the Contractor's proposals fail to meet the requirements of the Drawings, Specifications, or will be detrimental to the Works, existing substation infrastructures and not safe, the CEB shall have **at least seven (7)** full days to consider the Contractor's revised proposals. It is to be noted that the Method of Works, including the lifting plan and routing plan, shall be submitted per site.

Works at each site shall **ONLY** start following CEB no-objection to the proposed method statement submitted.

3.28 Explosives

The use of explosives will not be permitted.

3.29 Disposal of Spoil, Rubbish and Surplus Materials

No spoil, rubbish or surplus materials are to be dumped anywhere other than at a public or private disposal site controlled or appropriately licensed by a Local Authority.

The Contractor is to comply with all legislation governing the controlled disposal of contaminated material and of rubbish, and he shall state in writing to the Employer the location, for each contaminating substance, of the proposed disposal site areas and the means of transport to be adopted.

Where any excavated spoil, rubbish or surplus material has been deposited elsewhere than at an appropriately licensed disposal site, the Contractor shall indemnify the Employer against all proceedings and costs associated with the unauthorized deposition of such materials and shall bear all costs associated with clearing away such deposits and placing them in an acceptable site.

The Contractor may only temporarily stockpile materials on the site with the sole permission of the Employer. He shall do so only at locations agreed by the Employer. The Contractor shall ascertain that the local authorities have no objection to his proposals for any temporary stockpiling. Stockpiles shall be formed with smooth stable side slopes.

Scrap metal is to be collected and disposed through approved scrap dealers and removed from the site at regular intervals.

3.30 Existing Roads to Be Kept Clean and Maintained

The Contractor shall maintain all routes which he is using clean and free from any material arising from the Works to the satisfaction of the Employer. In particular, when vehicles involved in earth-moving operations are using or crossing any private or public roadway the Contractor shall have road-cleaning plant in attendance.

3.31 Dust Control

The Contractor shall take all reasonable measures, which shall include the provision and use of adequate water spraying equipment, to minimize dust nuisance. Particular attention shall be paid to the danger of dust from any hazardous material and the Contractor shall make adequate provision for damping down all working areas, haul routes, loads and stockpiles containing materials which may be harmful to the environment or health. Furthermore, any contaminated material stockpile on site shall be sufficiently covered or otherwise contained to prevent release of any airborne material which may be harmful to the environment or health.

3.32 Work On Live Equipment

For working on existing live equipment the CEB's Safety Rules shall be complied with. The Contractor shall comply with the CEB Permit-to-Work System and Safety Clearance Certificate, where required by the Employer and CEB.

3.33 Name Board

The Contractor shall erect at the Site, at the commencement of the Works, a nameboard approved by the Employer showing the project title and the name of the Employer. The nameboard may also include the name of the Contractor and of his principal subcontractors. The position, layout and size (which shall not be less than 3 m x 3 m) of the nameboard shall be agreed with Employer. No other advertisement will be permitted on the Site.

3.34 Good Housekeeping

Throughout the period of construction of the Works the Contractor shall carry out his operations in a clean, tidy and safe manner by arranging all materials and arisings and carrying out all operations in an orderly manner. All rubbish, waste materials, debris and the like shall be systematically cleared off the working area as it accumulates and all arising shall be securely loaded into hoppers, containers or lorries, as the case may be, as soon as it accumulates or is excavated and, if not removed directly off the Site shall be deposited at general collection points or in discrete stockpiles as agreed with the Employer pending removal from Site.

3.35 Safety Precautions

3.35.1 General

The Contractor and all persons employed by him on the Site in or about the execution of the Works shall conform in all respects with the provisions of all Acts, Orders and Regulations

made by competent authorities in Mauritius that shall be applicable to the Works or any temporary Works and binding upon the Contractor or persons employed as aforesaid and in particular, but without prejudice to the generality of the foregoing, such matters as concern the safety, health or welfare of persons working on the Site.

The Employer may require the immediate removal from the Site of any person who in the opinion of the Employer fails to observe properly the provisions of this Section and such person shall not again be employed upon the Works without the permission of the Employer.

The provisions of this Section shall apply to and be binding upon any subcontractor employed by the Contractor for any part of the Works on the Site and the persons employed by such subcontractor, and the Contractor shall ensure that proper and adequate provisions to this end are included in the subcontract.

The Contractor shall provide to his entire workforce, and to all other persons authorized to be on the Site, safety helmets complying with BS EN 397 and the Contractor shall ensure that all operations are carried out in accordance with the applicable safety recommendations of BS 8004 and BS 8008. At all times during site erection approved hard hats and safety boots must be worn by the Contractor's personnel.

During the construction of the Works, the Site shall be kept clean and tidy to the satisfaction of the Employer. Any waste material shall be removed from the Site at the Contractor's expense as directed by the Employer. Any damage done by the Contractor or his Subcontractors shall be made good at the Contractor's expense.

All required safety precautions shall be observed to ensure that any erection or mobile cranes used during construction shall in no way interfere with the existing 66 kV, 22kV and LV overhead lines and equipment.

3.35.2 Risk Assessment and Safety Measures

The Contractor shall carry out a complete risk assessment of each site covering the Works on site including mobilization, transportation and unloading of Containers, till taking-over by the Employer. A report shall be prepared, highlighting the risk and associated safety measures to be taken by the Contractor. A copy of the risk assessment reports shall be kept on each site for inspection, if any, by the relevant authorities. Two (2) copies of each risk assessment report shall be submitted to the CEB. The report shall be submitted fourteen (14) full working days prior to start of works at site. The risk assessment report shall be prepared and signed by a registered Safety and Health Officer and shall be in accordance to OSHA 2005 and associated regulations.

No Works shall start without the submission of the Risk Assessment Reports to the satisfaction of the Employer.

3.35.3 Risk Control Measures

Subsequent to an initial safety audit, remedial measures shall be provided by the Contractor in the design of the solar PV farm in order to minimize the risk during the initial construction, transportation and the subsequent operation and maintenance phase of the project.

The Contractor shall submit the risk assessment report to CEB for approval prior to start of work. The risk assessment shall also include the works to be carried out for the erection of the interconnection line and the work to be carried out in Grenade wind farm.

3.35.4 Site Safety Officer

A Site Safety Officer shall be employed by the Contractor and will be responsible for all aspects of safety and implementation of environmental impact requirements, including instruction, warning, signs, documentation, and first aid and ensuring that good housekeeping is maintained at site.
The Site Safety Officer shall remain responsible for ensuring that operations at the Site are at all times carried out in a safe manner and in accordance with the requirements of all legislation appropriate to the work in hand.

The Site Safety Officer shall be a competent person experienced in safety and welfare matters, and shall be fluent in the English language.

3.35.5 Fire Prevention/Protection

As part of its Safety Plan, the Contractor shall include a fire prevention and response plan. The Contractor shall perform all work in a fire-safe manner. The Contractor shall supply and maintain on site and on each piece of equipment, adequate fire-fighting equipment capable of extinguishing incident fires.

The Contractor shall comply with all local fire prevention regulations and secure necessary fire clearance certificate

3.35.6 Availability of Local Resources

The Contractor shall particularly note that there may be a high level of activity in the local construction industry and he shall take every precaution to ensure adequate availability of labor and materials. No claims will be entertained arising from any oversight by the Contractor in this regard.

3.36 Phasing Of Work At Site

Implementation at site shall be phased in such a manner as not to obstruct any CEB ongoing works at the same site. The Contractor needs to reflect this accordingly in the baseline

Programme of Works (PoW) initially submitted to the CEB, as part of the contract, and subsequent updated versions of the PoW.

3.37 Supervision of Works on Site

The carrying out of work included in the contract is to be supervised by sufficient number of qualified representatives of the Contractor and full facilities and assistance are to be afforded by the Contractor for the Employer to check the Works.

The Contractor's Representative on the Site or his nominated deputy is to be given full responsibility to enter into negotiations regarding points arising out of erection, so that the work may be expedited with as few delays as possible.

3.38 Items to Be Handed Over to Employer

The Contractor shall obtain a signed receipt by an authorized representative of the Employer for all documents, goods, materials, maintenance equipment, spare parts, instruments, etc., required by this tender to be handed over to the Employer other than the permanent works erected on Site.

3.39 Training at site

The Contractor shall provide training on the Site on all aspects of operation and maintenance of the Solar PV farm. The cost for training shall be quoted separately, that is as an OPTION by the bidder and listed in Section 7 – Schedule of Prices.

This shall include, but not limited to, classroom lectures and on-the-job training.

Classroom training shall cover at least the following:

a) PV power plant components and systems basic theory
b) Equipment sizing
c) Inverter technology selection, Matching PV modules to inverters
d) What MPPT is and why it is important for system performance
e) PV power plant system design
f) Foundation and Racking Design
g) Mounting Structure
h) Civil/Structural & Engineering Tips
i) DC and AC Cable Sizing
j) DC Voltage Drops and Energy Loss, and Combiner Box Layout and Design
k) AC Voltage Drops and Energy Loss, Layout and Design
l) Earthing System Design
m) Lightning and Surge Protection design

n) PV Plant Protection System design, coordination, installation, testing and commissioning
o) PV array structure design, construction and installation
p) PV power plant implementation due diligence
q) PV module field performance, plant monitoring (SCADA) and evaluation
r) Safety and quality standards,
s) O&M and assessment of solar PV plants
t) 22kV Switchgear operation, maintenance and troubleshooting
u) Relay configurations and settings.
v) Inverter configuration and settings
w) Transformer operation, maintenance and troubleshooting
x) The classroom training, including practical training, shall be of at least 2 weeks. The training schedule and contents shall be approved by the Employer prior to its start.

On-site training shall include, amongst others:

A. Operation of PV Plant:

a) Routine operation on SCADA system, programming and maintenance
b) Rebooting of SCADA
c) Relay configuration and settings
d) Inverter configuration and settings
e) Control philosophy
f) Switching Operations at Medium Voltage and Low Voltage
g) Start Up and Shut Down of the Plant
h) Fault recognition, tracing and diagnosis of system
i) Safety and quality standards to be respected during operation of the PV plant
j) Software installation and configuration of SCADA workstation and servers
k) As required, according to tools and equipment supplied under this project
l) UPS & DC System

B. Preventive Maintenance (PM):

a) PV Panel cleaning
b) Infrared scans of modules, combiner boxes, switchgear and substation
c) Vegetation management
d) Maintenance of mounting structures
e) Maintenance of cable connections (junction box, combiner box etc.)
f) Maintenance of inverters
g) Upkeep of data acquisition and monitoring systems (e.g., electronics, sensors)
h) Maintenance of LV and MV switchgears
i) Maintenance of transformers
j) Calibration, maintenance and cleaning of on-site monitoring stations
k) Upkeep of balance of system
l) As required, according to tools and equipment supplied under this project
m) Maintenance of UPS & DC System

C. Corrective Maintenance (CM):

a) Replacement of PV panels and Inverters
b) Repair of plug-in connections for panels
c) Appropriate repair in case of corrosion of mounting structures, module frames etc.
d) Repair and calibration of tracking system
e) Troubleshooting and repair of inverters
f) Replacement of burn-out fuses, fuse holders, circuit breakers, disconnectors, cables etc.
g) Troubleshooting and repair of LV, MV, HV switchgears and step up transformer(s)
h) Troubleshooting of MV switchgears protection system
i) Troubleshooting of data acquisition system
j) Troubleshooting and replacement of instrument in the monitoring stations
k) As required, according to tools and equipment supplied under this project
l) UPS & DC System

The Contractor shall make available to the Employer a Manual elaborating all the safety procedures for above mentioned interventions.

The Contractor shall provide the trainees with training manuals. The training manuals shall be submitted to the Employer for approval prior to commencement of training.

3.40 Design Review Meeting (s)

A design review meeting shall be held at the Employer premises, in Rodrigues, at a suitable time in order to expedite agreement of the proposed layout and set up, operation philosophy, protection systems and proposed equipment among others. If deemed necessary, additional project implementation review meetings shall be held at the Employer premises, with sufficient notice to all parties, until finalization and approval of the design. Any additional subsequent design meeting shall be conducted in the Employer premises.

3.41 Spare Parts

3.41.1 General Requirements

Each item shall be labelled with the makers part number and the Employer 's stock commodity code which will be notified when ordered, be separately packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 5 to 10 years storage in a dry weatherproof building.

All spare parts shall be delivered to the Site prior to the completion of the Works and the Bidder shall state in his Tender the latest date that spares shall be ordered to meet this requirement. If requested by the Employer, the spare parts shall be placed in bins, racks, drawers, shelves, cabinets, etc., to be provided by the Contractor.

The Contractor shall not use any of the spare parts without written permission from the Employer. All parts so used shall be replaced by the Contractor prior to the issue of the Taking Over Certificate.

3.41.2 Consumable Spare Parts

Five (5) sets of consumable spare parts necessary for the first five (5) years of operation shall be provided under the contract. These spare parts shall be listed and considered part of the bid. Price for every spare part shall be provided in the bid. The list of spare parts shall be as recommended by the respective manufacturer.

3.41.3 Spare Parts, Tools and Equipment

The Contractor shall, provide the following mandatory spare parts, tools and equipment as part of its offers. The price of same shall be included in the Contract price and every item listed in Section 7 – Schedule of Prices. Specifications of the tools and equipment shall be approved by the Employer prior to ordering.

Table 3.1: Mandatory Spare Parts, Tools and Equipment

Qty	Descriptions
50	PV Modules
10	Combiner boxes.
1	Inverter Module
10	Fuses of each size (AC and DC)
2	AC LV Air Circuit Breakers / Moulded Case Circuit Breaker
2	DC Circuit Breakers
2	DC Disconnect (Load Break Switch) of each rating
5	Surge Protective Devices of each type
1	Power Supplies/Converters of each type
1	I/O Modules for type used
1	Data Switch
1	PLC Controller readily programmed

Monitoring Station	
1	Complete set of Weather Monitoring Station

22 kV Switchgear	
3	Voltage Transformers
3	Current Transformers - Metering
3	Current Transformers - Protection
3	HRC fuses for VT
2	Charging motors
2	Protection Relay used on the MV Switchgear
2	Set of Voltage Release Coils

Tools	
1	RFID Reader
1	22 kV insulating mat
1 pair	22 kV insulating gloves.
1	Line tester (Both Visual and Audible)
1	Rescue Rod

3.42 Defects Liability Period

The defects liability/notification period for the whole installation shall be 24 months from the date of Taking Over.

Any defects reported by the Employer during the defects liability period shall be remedied by the Contractor within an agreed time frame between both parties. The Contractor shall use all reasonable endeavours to minimize any downtime and fault duration for the solar farm.

4.0 Contract Documentation

4.1 General

The English language shall be used on all documents and drawings and SI units shall be used throughout. Where Imperial units are required on civil works drawings because of the standard sizes of locally available material, these shall be shown in parentheses beside the SI units.

All reports, statements, returns, diagrams or drawings, etc., which the Contractor is required to submit to the CEB during the progress of the Works are, unless otherwise directed, to be furnished in triplicate.

4.2 Documents Required To Be Submitted For Approval

The Contractor shall furnish the following documentation, but not limited to, for approval. The documentation shall be in English, well detailed and instructive.

1. Project Schedule (Program of Works).
2. Method of Works
3. Project Procedures Manual.
4. Site Safety Procedures Manual
5. Conceptual design and layout of the PV farm
6. Complete schematic diagram of the PV system, 22kV Solar Switchgear.
7. Mounting structure drawings with structural calculations reviewed and certified by a licensed engineer.
8. Civil work layouts, plans and elevations inclusive of dimensions:

a) Layout drawings showing the row spacing and location of site infrastructures
b) Layout of all buildings and rooms.
c) Detailed structural and building works drawings and calculations.
d) Detailed building services drawings and calculations.
e) Civil works required for cable trenches, ducts etc.
f) Draining system

9. Quality Assurance Manual
10. Electrical (AC and DC) and control wiring diagrams
11. Electrical schematic Diagrams (AC and DC)
12. Electrical specifications:

a) Array
- Module type(s).
- Total number of modules.
- Number of strings.
- Modules per string.

b) PV String Information
- String cable specifications—size and type.

- String over-current protective device specifications (where fitted) type and voltage/current ratings.
- Blocking diode type (if relevant).

c) Array electrical details
d) Communication System between Grenade and Port Mathurin
e) Array main cable specifications—size and type.
   - Array junction box locations (where applicable).
   - DC isolator type, location and rating (voltage/ current).
   - Array over-current protective devices (where applicable)—type, location and rating (voltage/current).

f) Earthing and Lightning protection devices
   - Details of all earth/bonding conductors—size and connection points. This includes details of array frame equipotential bonding cable (where fitted), LV, MV switchgears and transformer earthing.
   - Details of any connections for Lightning Protection System (LPS).
   - Details of any surge protection device installed (both on AC and DC lines), to include location, type and rating.

g) AC system
   - AC isolator location, type and rating.
   - AC overcurrent protective device location, type and rating.
   - Residual current device location, type and rating (where fitted).
   - Grid connection details (transformers and switchgear schematics)
   - Internal electrical reticulation including transformers switchgears and protection systems.

h) Data acquisition and communication system
   - Details of the communication protocol.
   - Wiring requirements.
   - Sensors and data logging.
   - List of Signals and commands

i) 22kV switchgear Panels
   - Technical Specification and Cubicles arrangement
   - Electrical Wiring Diagrams
   - Protective Relays
   - Uninterruptible power supply.
   - Safety Equipment

j) Step up Transformer
   - Complete Technical Specification
   - Electrical Wiring Diagrams
   - Protective Relays

- Uninterruptible power supply.
- Safety Equipment

k) Wiring Diagram of the 22kV substation, control room and solar compact substation
a) Control Philosophy of the PV Plant and interconnection facilities
b) Complete Commissioning plan including test and start-up procedures
c) As-built drawings
d) Test Results
e) Installation manuals, instruction manuals and operation manual for all equipment and sub-subsystems.
f) Protection Philosophy, grading study and calculation for the PV Farm including the 22kV interconnection facility certified by a licensed engineer.
g) Repair and Maintenance schedule and manuals
h) Software documentation
i) List of signals, commands and alarms for both the PV Farm SCADA and associate remote control and monitoring system at Port Mathurin
j) PV Farm SCADA Screenshots and list of parameters being monitored.
k) Telecontrol
l) Calculation of heat dissipation for all LV panels, 22kV switchgear room and transformer cabin.
m) Trouble Shooting Manual.
n) Electrical protection settings
o) Risks assessment and safety measures
p) Electrical studies for sizing and choice of equipment.
q) Any other project documentation, drawings, manuals, methodology and specifications that the CEB find necessary for submission prior to implementation.

It is to be noted that all technical specification, drawings, layout and wiring diagrams shall be submitted for approval prior to manufacturing and implementation. The time frame for the submission of the above documentations and any other documentations that the Employer feel deemed necessary for the proper operation of the PV farm shall be agreed with the Employer at negotiation stage.

4.3 Format Of Drawings

All drawings prepared by the Contractor shall be in accordance with BS EN ISO 4157, BS EN ISO 6284, BS EN ISO 8560 and BS EN ISO 9431.

All drawings shall be to scale and fully detailed with a preferred maximum drawing size of A1. All-important dimensions shall be given and the material of which each part is to be constructed shall be indicated.

All drawings shall be black or colored lines on a white background with all revisions clearly marked and identified on the drawing.

All drawings shall bear an approved title block with the following contract reference:

Client: Central Electricity Board, Mauritius
Project: 1MWac PV farm at Grenade Rodrigues
Drawing Number and Revision:

The Contractor shall devise and use a drawing numbering scheme which shall be specific to the project, and which shall cover all Contractors and subcontractor and manufacturers drawings.

All symbols used on all drawings, diagrams, etc., shall be detailed in an accompanying legend and shall be in accordance with an agreed International Standard.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the CEB or not.

Drawings shall be prepared using AutoCAD 2010 (or later). In addition to the hard copies all drawings shall also be submitted in .dwg file format. All manufacturer drawings shall be submitted to the CEB.

4.4 Status Of Drawings And Documents

All documents and drawings prepared by the Contractor, subcontractor or manufacturer and submitted to the CEB shall be clearly marked or stamped with one of the following indications:

- For Approval
- For Comments
- Released for Construction
- For Information
- As Built

Documents submitted to CEB **without** one of the above Statuses will **not** be considered.

4.5 Procedure For Submission And Approval Of Documents

4.5.1 General

Contractor's documents (drawings excluded) shall include a title page followed by a revision record page clearly showing the revision history and showing the status of the document. The name of the author, reviewer and approver shall also be included.

4.5.2 Documents "For Information"

Two (2) copies of all equipment lists, data sheets, etc. shall be submitted to CEB **"FOR INFORMATION"**. The Contractor shall remain responsible for construction details, dimensions, etc. on the document. The CEB shall not normally respond to these submissions.

4.5.3 Documents "For Approval"

All drawings and documents required for approval shall be submitted to the CEB

Three (3) prints and one (1) electronic copy of all drawings which are required to be issued **"FOR APPROVAL"**, and one (1) print of all other documents which are required to be issued **"FOR APPROVAL"**, shall be submitted. The electronic copy may be in pdf file format but the final versions will be submitted in hard copies, pdf and AutoCAD formats.

Documents shall be either hand-carried or sent by courier service or express mail. The time for review of the Contractor's documents by the CEB shall be **14 days.**

When submitting a document for approval, including those prepared by a subcontractor or manufacturer, the Contractor shall certify that he has fully examined such drawings and that they comply with the requirements of the Contractor. For the purposes of this Section the term drawing shall also include diagrams, schedules, performance curves, etc.

Approval by the CEB will imply that:

- General arrangement and layout drawings and key diagrams have been examined and appear to be in accordance with the design concept of the project and meet the requirements of the Contract.
- Other drawings of equipment have only been examined in relation to compatibility of the equipment with the Contract and in respect of interconnections with other equipment.
- Any approval given by the Employment shall in no way relieve the Contractor of his responsibilities under the Contract.
- Modifications made as a result of the Employment's comments must be shown "clouded" on the revisions.

The CEB shall notify the Contractor of the status of the drawings as follows: -

APPROVED - On notification that a drawing is "**APPROVED"** the Contractor shall revise and re-issue it at "**RELEASED FOR CONSTRUCTION**" status and may then use this for the execution of the Works.

APPROVED SUBJECT TO COMMENTS - On notification that a drawing is "**APPROVED SUBJECT TO COMMENTS**", the Contractor shall revise it by incorporating the comments and showing "CEB's comments incorporated" in the revision block, and re-issue the drawing at "**RELEASED FOR CONSTRUCTION**" status.

Contractor may then use this for the execution of the Works. “”. In the event of the Contractor not complying with all the CEB's comments, the drawing shall be re-submitted for approval.

EXAMINED AND RETURNED WITH COMMENTS - On notification that a drawing is **"EXAMINED AND RETURNED WITH COMMENTS"** the Contractor is notified the drawing is not considered satisfactory and shall be amended and re-submitted for approval.

EXAMINATION NOT REQUIRED - If a drawing is notified as **"EXAMINATION NOT REQUIRED",** the submitted drawing does not come under the categories shown in Section 4.5.2 above. Such drawings will include detailed manufacturing drawings which the Contractor would normally only make available to the CEB when requested to do so.

4.5.4 Documents "FOR COMMENTS"

In order to enable the CEB to review and comment upon the Contractor's design and engineering work, certain drawings, calculations and documents, selected by the CEB, shall be submitted to the CEB "**FOR COMMENTS**" prior to release.

4.5.5 Documents "RELEASED FOR CONSTRUCTION"

The Contractor shall observe all comments by the CEB unless he is not in agreement with the comments, in which case the comment in question shall be discussed with the CEB. After implementation of the comments or when notice of no comment has been received, the Contractor shall issue to the CEB two copies of the drawings as **"RELEASED FOR CONSTRUCTION”.**

The Contractor's documents which have been approved by the CEB and are thus ready for subsequent action (i.e. for construction, etc.) shall be issued marked **"RELEASED FOR CONSTRUCTION".**

The Contractor shall ensure that **all** Contract drawings shall have reached the **"RELEASED FOR CONSTRUCTION"** stage before site erection has commenced. Work on Site will not be permitted to proceed until the drawings required have reached “Released for Construction” status.

4.5.6 “AS BUILT” Drawings

The final configuration, system logic and spatial arrangements of all permanent works shall be recorded on “**AS BUILT**” drawings. Where changes have been made to “**RELEASED FOR CONSTRUCTION**” drawings these shall be back drafted in AutoCAD and the changes shown clouded or otherwise in a manner that makes it clear the nature of the change.

All “**RELEASED FOR CONSTRUCTION**” drawings shall then be revised and the status changed to “**AS BUILT**”. These “**AS BUILT**” drawings shall then be submitted to CEB for review.

4.6 Planning And Progress Monitoring

4.6.1 General

To ensure satisfactory interchange of information such that the Contract can be correctly controlled and monitored the Contractor shall strictly adhere to the following specified procedures with regard to planning and progress monitoring.

4.6.2 Project Procedures Manual

Within four (4) weeks after the Letter of Acceptance, the Contractor shall submit **"FOR APPROVAL"** a Project Procedures Manual which shall detail the Contractor's standard procedures covering the individual phases of the project over the full Contract period for:

- Project management and organization
- Responding to CEB's comments on drawings and documents
- Progress reporting
- Communication
- Controlling and monitoring
- Procurement
- Manufacturing
- Shipping
- Completion of all contract documentation
- Installation
- Testing and commissioning
- Invoicing and certification
- Variations to contract

Organigrams shall be included to show head office, site, shipping and transportation departments together with overall interfaces between the different sections and in particular identifying formal points of contact in each department, or otherwise, for liaison with the CEB responsible officers.

The Manual shall also include: -

- Dates of meetings between the Contractor and the CEB, incorporating the meetings described in 2.11 above;
- Dates required by the Contractor for review and approval by the CEB of drawings and documentation;
- A draft inspection schedule detailing all items that require third party inspection. The CEB will determine and inform the Contractor, in writing, of the level of inspection in which the CEB wishes to be involved;
- A flow and routing diagram for drawings and Contract documentation which shall indicate the Contractor's procedure for producing, quality controlling and

submitting drawings and documents for review by the CEB. The documents shall include bills of lading, inspection procedures/ notification of inspections, reports and manuals;

- Documentation distribution schedule which shall detail the recipients and total number of copies required for significant documentation including minutes of meetings, progress reports and manuals.

4.7 Subcontractors

Where the Contractor subcontracts major items it will be the Contractor's responsibility to instruct his subcontractors as to the requirements for programmes and documentation which shall also comply with the requirements of this Specification.

4.8 Programme of Works

The programme of works (or programme) to be submitted by the Contractor shall be in the form of a bar chart clearly identifying each separate activity and milestone and showing the earliest and latest start and finish dates against each activity. The critical path shall be clearly identified.

The programme shall show completion of the Works within the Time for Completion as specified in this Tender. The programme shall clearly show the key dates required to be met by others and all interfaces with existing system. All similar disciplines shall be grouped together.

4.9 Modifications to the Contract Programme

If at any time during the execution of the Contract the Contractor considers it necessary to modify the Contract Programme, he shall inform the CEB in writing, whilst clearly stating the reason(s) for the variation and re-submit the modified programme without delay as a variation to the baseline programme of works. The revision/version number of the modified programme shall be labelled and recorded accordingly. Approval of changes to the programme shall not constitute approval of any extension to the guaranteed completion dates.

4.10 Site Progress Reports

In addition to the reports and returns described in the Conditions of Contract, the Contractor shall submit to the CEB weekly Site Progress Report as from start of work on Site. These reports shall cover the work executed from midnight on Sunday to midnight the following Sunday, and shall be submitted to the CEB by the Monday end of business following the week covered by the report.

It shall also contain the weekly work plan for works to be executed the following Tuesday up to next Monday. The Contractor shall submit a format of its Site Progress Report for approval **fourteen (14) business days** prior to start of works. The Employer reserve the rights to request for any additional information to be included in the Site Progress Reports during the execution of the project.

The Contractor shall issue **a copy of** the Site Progress Report.

4.11 Monthly Progress Report

The Contractor shall issue a monthly progress report in accordance with Sub Clause 4.21 – Progress Report of the General Conditions of Contract (Section 2 – Part I of the bidding documents) as amended in the Conditions of Particular Application (Section 3 – Part II of the bidding documents).

4.12 Progress Monitoring and Control

If at any time it should appear to the CEB that the actual progress of the Works does not conform to the approved program referred to above, the Contractor shall produce, at the request of CEB, a variation report explain the reason(s) for the delay(s), if any, as well as a revised program showing the modifications to the approved program necessary to ensure completion of the Works within the time for completion.

4.13 Site Safety Procedures Manual

Within **eight (8) weeks** prior to start of Site Works the Contractor shall submit **two copies** of his site safety procedures manual and shall also indicate the name and contact details of the person responsible for site safety matters.

4.14 Civil Engineering Report

A Civil Engineering Report shall be submitted to the CEB for approval at least **six (6) weeks** from start of civil works at site. Information to be provided shall include but not be limited to the following:

- Copy of geotechnical survey and interpretation of results; a copy of the geotechnical report for the existing wind farm is being attached for information only. The information is being provided without liability as to its accuracy and no responsibility will be accepted as to its validity or accuracy. The Contractor shall carry out all other surveys and additional investigations he deems necessary for the design and completion of the works.
- A topographical survey of the site where construction will take place has to be submitted. Details of personnel employed for the design of civil works including positions held and curriculum vitae;
- Details of key personnel to be employed on site during the construction period. These shall include the site management team and quality control engineers;
- Information on types of foundations and structures selected for the works;
- List of codes of practice to be used for the designs;

- Details of all loadings, both actual and assumed, incorporated into the designs. Where interpretation of codes of practice is required (e.g. for wind loading) the results shall be clearly stated;
- Details of any computer programs to be used for the design.
- The Civil Engineering Report shall be approved by the CEB prior to start of works.
- Description of making good of site.

4.15 Commissioning Procedures Manual

The Contractor shall submit two copies of his comprehensive commissioning procedures manual **"FOR APPROVAL"**. These documents shall be submitted **one (1) month** prior to commencement of commissioning of the Works. Following approval, the Contractor shall supply **three (3) copies** of the final documents.

The documents shall include detailed checklists and test sheets of all checks and tests to be carried out on all equipment during the commissioning phase of the Work. Each checklist and test sheet shall have included a space for the Contractor's signature which must be signed by a competent representative of the Contractor when the complete PV farm has been successfully commissioned. Each sheet shall also include a space for the CEB's representative's signature which may be signed if the particular test/check has been witnessed by the CEB's representative. However, absence of the CEB's representative in witnessing such checks or tests shall in no way relieve the Contractor's contractual liability in this regard.

Commissioning on Site shall **only** start after approval of the Commissioning Procedure Manual.

4.16 Documents Required For Final Records

4.16.1 Introduction

"As Built" versions of all drawings are required for the final records. In addition to the documents and drawings required for procurement and construction, the Contractor shall supply the documents listed below for final record purposes.

4.16.2 Operating Manuals and Maintenance Instruction Manuals, Spare Parts Manuals & Equipment

Regarding the requirements for submittal of these manuals, Contractor's standard format for Operating and Maintenance Manuals, Spare Parts Manuals will be acceptable provided that they contain the information required below and are well laid out and professionally presented.

Not later than one month prior to the commencement of commissioning of the Works the Contractor shall deliver direct to the Employer three (3) completed and approved sets of the relevant operating manuals, three (3) completed and approved sets of the relevant operating manuals and three (3) sets of the relevant maintenance manuals as detailed herein, and three (3) sets of the relevant operating and maintenance manuals in electronic data (CD ROM) format. The documents submitted shall not be a general one for a range of equipment. **It shall be very specific of the equipment being delivered on site.**

Failure to comply with the submission requirements will result in delayed progress payments from the CEB.

Any approved modifications completed to the Works during erection and commissioning shall be reflected in the O&M Manuals. In addition, the CEB may request for additional information to be included in the O&M Manuals. In this event the relevant sections shall be amended as "As-Built" and issued within one (1) month after the Taking-Over Certificate.

The manual contents shall conform to the Table of Contents and be as complete and specific as possible. Every attempt shall be made to use material specific to the Contract. Nomenclature or reference to any one item shall be consistent throughout the manual.

The information provided shall be complete for main and auxiliary equipment and systems provided by the Contractor. Material that does not contribute to the understanding of the design, operation and maintenance of the equipment shall be excluded from the manual.

Use shall be made of drawings, diagrams, pictures or actual photographs when they add to the understanding and clarity of the text.

All material shall be free from stamps commonly used for identification of customer, order number, etc.

Precautions and warnings relative to the safety of life and equipment shall be included where practicable.

The manuals shall be divided into volumes specific in respect of the complete Contractor works. The Operating Manuals shall be separate from the Maintenance Manuals. The Maintenance manual shall also contain a section specific to the handling of major equipment in and out of the station, switchgear and any part of the PV system.

Arrangement and Format of Operating the Manuals shall be approved by the CEB prior to printing and submission to the CEB.

4.16.3 "AS BUILT" Drawings

"As-Built" drawings shall be issued in accordance with Sub Clause 5.6 of the General Conditions of Contract (Section II-Part I of the bidding document). They shall be issued at "**AS-BUILT**" status and are required as part of the Final Record. All "Issued for Construction" drawings are to be re-issued as "As-Built".

During the construction and commissioning period any variations between the **"RELEASED FOR CONSTRUCTION"** and **"AS BUILT"** situations shall be agreed between the Contractor and CEB.

The Contractor shall submit all final revisions of all original drawings depicting the "**AS BUILT**" situation of the Works **four (4) weeks** after the issue of the Taking-Over Certificate. All drawings and documents prepared exclusively for the project shall become the property of the CEB.

Final drawing prints shall be size A1 or A2 formats. Final drawings shall be supplied as follows: -
Three (3) print of each drawing included in the Operation and Maintenance Manuals.
One (1) CD-ROM to the CEB and one (1) CD-ROM to the CEB containing original AutoCAD drawing files.

Where drawings are reduced an appropriate scale shall be included on the reduced print.

To accompany the drawings, the Contractor shall provide a Master Schedule of "As Built" drawings.

4.16.4 Commissioning Reports

The Contractor shall submit **three (3) copies** of his comprehensive Commissioning Reports covering the commissioning periods at site including tests. The reports shall be submitted within four (4) weeks of the issuing of the Taking-Over Certificate. It is to be noted that the commissioning of the complete PV system shall include the reports shall include at least the following:

- Description of the tests performed including the acceptable limits of test results as per related standards.
- A written summary of commissioning noting particularly the problems that were encountered and the actions undertaken to resolve these.
- Defects which have occurred and the remedial action to resolve.
- Signed Checklists and Test Results
- FAT reports for PV modules, inverters, transformers and switchgears among others.
- Drawings where necessary for ease of referencing.
- Equipment and tools used to perform the different tests on site.

- Calibration Certificates of the different test equipment and tools used
- Weather Monitoring stations sensors' calibration certificates.

5.0 Civil Engineering Works

5.1 General

The Contractor shall design, detail, procure, supervise and commission the required civil, structural and building works associated with the project. The Contractor shall also undertake all studies and investigations (such as geotechnical investigations and topographical survey) necessary for the design and construction of the civil, structural and building works. The Contractor shall carry out all enabling works (diversion of services, temporary access, storage and welfare facilities etc.) that are required for the completion of the works. The Contractor shall provide a Registered Professional Civil Engineer to supervise and approve the civil engineering works during the construction works.

The civil engineering works shall include the design and construction, among others, of the following:

- Leveling of ground, where required;
- Develop access roads and track roads (Compaction tests shall be carried out at every (Max) 300 mm thick layer, where there would be vehicular traffic) as per requirement in Drawing S-5191;
- Design and implement a proper water drainage system including water retention wall behind the existing and new building;
- Design and implement a loading/unloading area 3m wide within the area between the existing building and new building which will be constructed by the Contractor;
- Foundations for Module Supporting Structures;
- Cable Trenches/ducts (Compaction tests shall be carried out at every (Max) 300 mm thick layer;
- Transformer Bases in Solar Compact Station;
- Provision of the Architectural Design as per requirement in Table 5.1 below.

	Rooms	Min Surface area
1.	Switchgear Room	Refer to Drawing 6645-18
2.	Store	25 m^2
3.	Electrical Room	16 m^2
4.	Control Room	12 m^2
5.	Compact Station (Transformer Room and LV AC Room)	To be determined by Contractor
6.	Toilets	To be determined by Contractor

Table 5.1: Building requirements

Note: The Architect may allocate spaces as he/she deems fit.

- Submission of Architectural drawings signed by a professional registered Architect.

- Structural Design for the one floor building and the two solar compact stations Submission of calculations and drawings for the structural design, signed by a professional registered Engineer (Civil). The structure shall resist wind gust of 280 km/h for 3 seconds and the structure shall be designed as frame structure.
- Construction of the one floor building and two compact stations complete with all openings and finishes.
- Construction of Soakage Pit on the cable ducts at 3.0m intervals having overall size 500 x 500 x 1000mm deep including all necessary excavation in any type of soil including rock strata and subsequent backfilling with selected grade 20/40 aggregate and remaining 150mm top layer with 10mm single size aggregate. Works to also include for laying of geotextile membrane type Kaymat U14 all around 14-20mm aggregate.
- Provision for manhole and pits for transformer oil.
- Implement necessary measures to control surface drainage from cuts and fills and prevent erosion and sedimentation.
- Provision of asphalted driveway as shown in drawing number S-5191.
- Provision of two solar compact stations inclusive of transformer bases and access roads. The access roads to the two solar compact stations be asphalted.
- Provision of the necessary rain water pipes, catch pits, soak away, concrete kerbs, proper landscaping inclusive of flower boxes near the buildings.
- The finish floor level shall be 500mm above the existing ground level.
- The finish level for the PV array foundation/stud column shall be 100mm above the ground level.

The Contractor shall make its own estimate of the types and of the extent of the various materials to be required to accomplish the above works. Approval shall be sought for the dimensions as well as the layout and outlook of the buildings to be constructed, during the design stage.

5.2 Modules Mounting Structures

All structures and foundation designs must include suitable evidence to show that their design is commensurate with a minimum of 25-year life. The calculations and design shall be submitted to Employer for approval prior to implementation.

The Contractor shall design the PV arrays' mounting systems, foundations, and piers. The design shall be based upon standard industry practice, including the requirements of applicable codes, standards, and permits, as well as the information/specifications provided by the module manufacturer. The supporting structures shall be able to withstand gusts of at least 280 km/hr for 3 seconds.

Structural material shall be corrosion resistant (and resistant to the saline environment) and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. The material for the supporting structures of the PV panels shall be hot dipped

galvanized steel and should resist corrosion. Galvanizing should meet ASTM A-123 hot dipped galvanizing or equivalent which provides at least spraying thickness of 70 microns on steel as per BS EN ISO 1461:1999, if steel frame is used. Aluminium frame structures with adequate strength and in accordance with relevant BS/international standards can also be used. Bolts, nuts and washers shall be stainless steel grade 316. As per figure below, the minimum ground clearance of the PV Mounting Structure shall be 1600 mm.

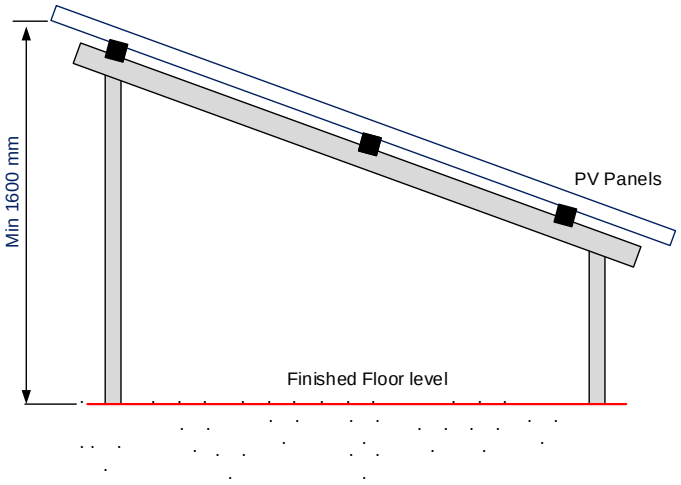

Figure 5.1 Minimum Ground Clearance for PV Mounting Structure

Structures shall be supplied complete with all members to be compatible for allowing easy installation. 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.

The Contractor 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:

- Determination of true north at the site;
- Array tilt angle to the horizontal;
- Details with drawings for fixing the modules;
- Structure installation details and drawings;
- Electrical cabling and grounding (earthing);
- Inter-panel/Inter-row distances with allowed tolerances
- Safety precautions to be taken.
- Ground cover ratio (GCR) i.e. Module area compared to area of land required.

The Contractor is required to fill the Technical Schedules in the Schedule List (Appendix B) and submit the terms for product warranty.

All drawings and installation details shall be approved by the Employer prior to installation.

5.3 Specification For Excavation, Hardcore Filling

5.3.1 Inspection of Site

The Contractor or sub-contractor is deemed to have visited the site and to have ascertained the nature of the material to be excavated, and likely accumulation of rain water, prior to submission of his offer as no claims will be allowed on the grounds of ignorance of conditions under which works will be executed.
The Contractor shall ascertain the nature of the ground to be excavated/disturbed, carted away, thereafter likely to cause any problem of dust nuisance to the Environment. All remedial measures to stop blowing of dust such as by watering etc will be deemed to have been included in his price.

5.3.2 Dealing with water

The Contractor's attention is drawn to the depths below ground level on the foundations and to the water level requiring him to deal with water. Unless otherwise specified the Contractor will be required by pumping or other means to the Engineer's approval to keep the excavations dry during construction.

5.3.3 Shoring and strutting

The Contractor's attention is drawn that the rate for excavation includes for any shoring and/or strutting required to the sides of the excavation to walls footings, column bases, etc. Also the rate includes for propping/strutting of caves in excavation where required.

The structure of the adjacent or nearby building or buildings shall be shored as required by the drawings and/or instructions of the CEB before starting excavation in proximity of the existing structure. The Contractor's attention is drawn to the need to carry out the excavation in stages approved by the Engineer.

5.3.4 Excavate to Reduce level and to Dimensions

Excavate site as shown on drawings to form the foundations to width and depth indicated, the bottom of all excavation to be clean perfectly level, and/or stepped as shown or as instructed.

The price of excavation is to include for excavation (and their removal from site) of all materials encountered, upholding the sides of excavations; to that effect, the Contractor must visit the site of works to assess the nature of the subsoil likely to be encountered.

The price of excavation is to include for excavation required for working space, keeping excavation dry during construction, shoring and strutting, as well as for any overbreak due to nature of soil/rock, method of excavation or any other reason.

The ground below basement slab, column bases and strip footing to walls will be excavated to exact required level, i.e. last 150mm depth by hand and where found in sand and/or loose stratum, it shall be compacted with 8 passes (i.e. 4 in each direction) with 1.25 ton vibrating roller or mechanical tempers before blinding.

Any overbreak due to nature of soil/rock/boulders, method of excavation or due to any other reasons, excavations to width or depth greater than those shown on the drawings or as instructed by the CEB shall be filled by the Contractor at his own expense in such depths or width of excavation beyond that instructed or shown, with concrete grade 15/20 to the satisfaction of the Engineer.

5.3.5 Rock

"Rock" means any hard material, which in the opinion of the CEB can be removed only by use of compressors or by wedging and the CEB's opinion shall be final. Decomposed rocks, tuff or other material which can be removed by pick, traxcavator, or any other mechanical means will not be classed as rock. All material classified as rock may if approved by the engineer, be used as hardcore filing and the measured quantities of imported hardcore will be adjusted accordingly. All rock so used must be broken to the required size as hereafter described for hardcore before being used.

Boulders of a dimension 400 mm or less and/or of volume 0.064 m^3 or less will not be classed as "Rock". No blasting will be permitted.

5.3.6 Bottom of excavations to receive foundations

The Contractor shall report to the CEB when secure bottoms to the excavations have been obtained. Any concrete or other work executed before the excavations have been inspected and approved, shall if so directed, be removed and new work substituted after the excavations have been approved, all at the Contractor's expense.

The surface of the bottoms to excavations shall be leveled or graded to falls as required, compacted as specified above just prior to blinding. Bottom formed in clay or silty stratum shall not be left exposed before inspection by the Engineer. Upon arrival, a layer of concrete class 15/20 blinding (maximum 20 mm gauge aggregate) or concreted with mass concrete as shown on drawing shall be placed and finished to a smooth surface with a wood float.

To receive tanking membrane, all corners and edged are rounded off or filled with 25mm radius with cement sand (1:3) mortar.

5.3.7 Under floor filling

Where shown approved filing under the thickness of hardcore shall be made of any of the following or mixed:

Excavated material of decomposed rock when stacked/ stored separately from material other than rock.

- Sand
- Stones of size not exceeding 225 mm
- Pieced of concrete blocks and site cast concrete mixed of size not exceeding 225 mm.

The stone/excavated decomposed rock fill should not contain clay/silty soil in excess of 10% by volume if found mixed. The layers of approved fill shall be well watered, compacted before placing the layer of hardcore.

5.3.8 Materials found in excavations

No material found in the excavations should be used in the works without the written permission of the Engineer.

5.3.9 Hardcore filling

Hardcore shall be good hard stone ballast to the approval of the engineer broken to pass not greater than 150mm ring or to be75% of the finished thickness of the layers being compacted whichever is the lesser and graded so that it can be easily and thoroughly compacted by rolling crusher run may be used instead of hardcore, with prior approval of the Engineer.

The hardcore is to be laid in layers each of a consolidated thickness not exceeding 225mm and well watered and rolled with a vibrating roller (minimum one and a quarter tons) or a ten ton roller, each layer for minimum of 8 passes until no visible settlement is noted. Where rolling is impossible, compaction shall be by hand or mechanical tempers. Thereafter, top surface of the hardcore shall be leveled or graded to falls as required and blinded with similar material broken to 25 mm gauge and surfaced with a 15 mm layer of rock sand, well watered and rolled. Rolling for minimum 4 passes until no visible settlement of the top is noted.

5.4 SPECIFICATIONS FOR CONCRETE

5.4.1 Code of Practice for Concrete Works

All workmanship, materials, tests and performance in connection with the British Code of Practice BS 8110 for the Design, materials and workmanship for " The Structural Use of Concrete" and BS 8007: 1987 " Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids "where not inconsistent with these Preambles.

5.4.2 Cement

Cement unless otherwise specified shall be Portland Cement of strength class 42.5N complying with the requirements of BS 12: 1991 and a manufacturer's certificate of Test in accordance with BS 12: 1991 shall be applied for each consignment delivered to site.

Cement may be delivered to the site either in bags or in bulk.

If delivered in bags, each bag shall be properly sealed and marked with the manufacturer's name and shall be stored in a waterproof shed of adequate dimensions with a raised floor. Each consignment shall be kept separate and marked so that it may be used in a sequence in which it is received. Any bag found to contain cement which has set or partly set, shall be completely discarded and not used in the works. Such bag/bags shall be removed from site within 24 hours. Bags shall not be stacked more than 1.5m high.

If delivered in bulk, the cement shall be stored in waterproof silo either provided by the cement Contractor or by the Contractor but in either case the silo shall be to the approval of the Engineer.

5.4.3 Aggregates

Aggregates shall conform to the requirements of BS 882:1992 and the sources and types of all aggregates are to be approved in all respects by the Engineer before work commences.

The grading of aggregates shall be one within the limits set out in BS 882 and as later specified and the grading, once approved, shall be adhered to throughout the works and not varied without the express prior approval of the Engineer.

Fine aggregates shall be clean, washed, crushed rock sand and coral sand of hard quality and shall be free from lumps of stone, earth, loam, dust, salt, organic matter and any deleterious substances. The maximum quantities of material passing the 75µm sieve shall not exceed the values given in Table 6 of BS 882:192.

Coarse aggregate for concrete shall be crushed blue basalt stones to the approval of the Engineer. It shall be hard, clean and roughly cubical in shape, non-porous, free from dust, decomposed stone, clay, earthy matter, foreign substances or friable, thin, elongated or laminated pieces. It shall be graded within the limits of Table 3 of BS 882 for graded aggregates. The flakiness index shall not exceed 40.

If in the opinion of the Engineer, the aggregate meets with the above requirements but is dirty or adulterated in any manner it shall be screened and/or washed with clean water, if he so instructs, at the Contractor's expense.

Aggregates shall be delivered to the site in their prescribed sizes or gradings and shall be stock-piled separately on paved areas or boarded platforms in separate units to avoid intermixing, excessive segregation and contamination with other materials. On no account

shall aggregates be stock-piled on the ground. Fine aggregates shall be allowed to drain until it has reached a uniform moisture content before it is used.

Moisture/water content in fine and coarse aggregate will be measured daily and the amount of free water is taken into account before adding water to arrive at the w/c ratio of the approved design mix of concrete.

5.4.4 Quality of Mixing Water

Water of chemical composition acceptable for drinking is suitable for concrete.
The water used for making and curing concrete and mortar shall be free from objectionable quantities of silt, organic matter, alkalis, salt or other impurities. In particular, inorganic matter in solution shall not exceed 500 parts per million by weight and in suspension shall not exceed 30 parts per million by weight and the total alkali bicarbonate/carbonate content of the water shall be less than 1000 parts per million by weight.

The water shall be from an approved source and shall contain no deleterious matter which significantly affects the setting time or strength or durability of the concrete or which has any effect on the appearance of the hardened concrete by discoloration or efflorescence or prevents the achievement of the approved test cube strengths at 28 days for the appropriate grade of concrete.

The Contractor shall test the water which he proposes to use and shall submit the records of such tests to the Engineer before placing any concrete in the permanent works.

The Contractor shall make regular tests of the water during concrete construction works. The water shall be sampled at the point of discharge into the mix and the frequency of sampling shall be as approved by the Engineer.

5.4.5 Admixtures

Concrete admixtures shall comply with BS 5075 or ASTM C494 shall be allowed with the prior approval of the Engineer. “Plasticiser” where used will be added to the mixing water in proportion recommended by the manufacturer and strictly in accordance their written instructions, to achieve better workability. No additional cost will be paid for the use of plasticizer.

5.4.6 Floor Hardener

Where floor hardener is specified for concrete floor, it shall be ‘Sika’ Chapdur Premix or approved equivalent and shall be used as per manufacturer’s instruction.

5.4.7 Reinforcement Materials

Steel reinforcement shall be plain mild steel bars or high yield deformed bars complying with MS 10 (2002), or cold worked deformed bars complying with MS 10. Steel reinforcements

shall be cut straight from straight bars free from kinks and bends or other damage and cold bent by experienced competent workmen. At the time of incorporation in the works the reinforcement shall be clean and free from loose mill scale and loose rust.

Bars of diameter 20 mm or greater shall be bent in a bending machine designed for the purpose and approved by the Engineer. Bending and cutting shall be in accordance with BS 4466 unless otherwise specified or ordered by the Engineer.

The Contractor shall supply the Engineer with the certificates of the manufacturer issued in compliance with MS 10 for all the required tests, including the rebend test, in respect of each consignment delivered to site.

Steel fabric reinforcement shall comply with MS 34 & MS 35.

Steel reinforcement shall be stored sheltered and supported by wooden blocks so as to prevent sagging. Bars shall be stored in separate lots according to diameter and quality. No claim on account of non-availability of bars up to 12 metres lengths will be allowed.

5.4.8 Fixing reinforcement

Reinforcement shall be accurately bent to the shapes and dimensions shown on the drawing and in accordance with BS 4466. Reinforcement must be cut and bent cold and no welded joints will be permitted unless so detailed and approved by the Engineer.
Reinforcement shall be accurately placed In position as shown on the drawings and shall be secured against displacement by using No 18 S.W.G annealed binding wire or suitable clips at intersections and laps, and shall be supported by approved concrete, plastic or metal supports, steel chairs, spacers or metal hangers to ensure the correct position and cover before concreting and shall be kept in the same position during concreting. However, metal supports, chairs, etc. shall have minimum 12mm cover made of concrete blocks, or shall have approved plastic shoes.

5.4.9 Position and Correctness of Reinforcement

No concreting shall be commenced until the Engineer has inspected the reinforcement in position and until he has approved the same. The Contractor shall give two clear days' notice of his intention to concrete. The minimum period between two inspections shall be 24 hours.

Irrespective of whether any inspection and/or approval of the fixing of the reinforcement has been carried out as above, it shall be Contractor's sole responsibility to ensure that the reinforcement complies with the details on the drawings and is fixed exactly in positions shown therein and in the position to give the prescribed cover.

The Contractor will be held entirely responsible for any failing or defect including crack in any portion of the reinforced concrete structure and including any consequent delay, claims third party claims, etc., where it is shown that the reinforcement, has been incorrectly positioned or it is incorrect in size or quantity with respect to the detailed drawings.

Unless otherwise allowed by the Engineer, reinforcement shall not be bent after being embedded in hardened concrete.

Unless otherwise instructed concrete cover to reinforcement bars in any face shall be as per below.

Substructure	**A** For all members of structures located more than 300m away from the sea and at altitude less than 350m, above Mean Sea Level and for internal members fully covered to weather for structures located in B (mm)	**B** For external members exposed to weather for structures located in proximity of sea within 300m from sea and for structures at altitude greater than 350m (mm)
Foundations against earth face	75	75
Foundations against blinding	50	50
Columns & walls below ground or against water face	40	40
Ground beams	30	35
Slab on hardcore	30	35
Superstructure		
Columns:		
>200 mm	35	35
200mm or less	25	25
Beams and walls	30	35
Suspended slabs	20	25

The above cover shall be decreased by 5mm for concrete surfaces to be finished with cement mortar rendering/screed.

For underground work likely to be affected by sea water, the above cover shall be increased by 25 mm.

For post-tensioned slabs, the minimum cover to polyethylene sheaths of unbounded tendons or to metal ducts for bonded tendons should not be less than 25m.

5.4.10 Design of proposed mix

Maximum Nominal Size of Aggregate in the Mix (mm)	Minimum ratio	Maximum Ratio for Normal concrete	Max. ratio for Pumped Concrete
10	0.45	0.55	0.55
14	0.40	0.50	0.50
20	0.35	0.45	0.47
40	0.30	0.40	0.43

Concrete grades and strengths

Grade Of Concrete	Characteristic Compressive Strength At 28 Days (N/Mm²)	Compressive Strength Compliance Requirements			
		Any individual test result (N/mm²)	Mean of a group of test results		
			First 2 (N/mm²)	First 3 (N/mm²)	Any consecutive 4 (N/mm²)
15/20	15	13	15	16	17
20/20	20	17	21	22	23
25/20	25	22	26	27	28
30/20	30	27	31	32	33
35/20	35	32	36	37	38
40/20	40	37	41	42	43
45/20	45	42	46	47	48

50/20	50	47	51	52	53

Note: the strength requirements given above shall apply irrespective of the maximum size of aggregates used.

Maximum cement content and maximum water/cement ratio

Grade of Concrete	**Maximum Cement Content (Kg/m³)**	**Maximum water/cement ratio**	
		A	**B**
15/20	200	0.70	X
20/20	250	0.65	X
25/20	300	0.60	X
30/20	325	0.60	0.55
35/20	350	0.58	0.53
40/20	400	0.55	0.48
45/20	425	0.50	0.45
50/20	450	0.47	0.45

Notes:

The minimum cement contents given above are per cubic metre of compacted concrete made with 20mm nominal maximum size of aggregates. For maximum aggregate size of 12 mm, the minimum cement content should be increased by 40 Kg/m³.

For maximum aggregate size of 40 mm, the minimum cement content may be reduced by 30 Kg/m³.

Under the heading "Maximum water/cement ratio", column A applies to sheltered and average conditions and column B applies to severe conditions and water retaining structures. Also the column A and B apply respectively to members mentioned in Column A and B of Table 2.08 of Article 2.08.

Use of "An approved Concrete Admixture" to BS 5075 or ASTM C494 to achieve the strength with the maximum water/cement ratio as tabulated above is allowed.

Use of more than 40 kg over and above the minimum cement content specified and tabulated above is not allowed.

NOMINAL VOLUMETRIC MIX

Description	**Mix 30/20** **1:1.8: 2.8**	**Mix 25/20** **1 : 2.4 : 3.8**	**Mix 20/20** **1: 2.7 : 4.2**	**Mix 15/20** **1: 4: 6**

Cement	A bag of 50 Kg	A bag of 50 Kg	A bag of 50 Kg	A bag of 50 Kg
Crushed rock sand	0.0355 m³	**0.0497** m³	**0.0532** m³	**0.071** m³
10mm to 5mm graded aggregate	0.0284 m³	**0.0355** m³	0.0426 m³	0.071 m³
20mm to 10mm graded aggregate	0.0710 m³	0.1094 m³	0.1136 m³	0.1419 m³
Maximum water/ Cement ratio	0.55	0.60	0.65	0.70
Maximum Slump	50 mm	50 mm	50mm	50 mm

Note: 1 bag of cement i.e. 50 Kg = 0.0355 m³

5.4.11 Ready Mixed Concrete

The Contractor shall ensure that the requirements of these specifications are complied with.

Further to the above requirements, the Contractor shall ensure that transport and delivery of ready mixed concrete comply with the recommendations of clause 4.10.4 of BS 5328:Part 3 : 1990.

The concrete shall be transported to the site in truck mixers from the mixing plant premises and shall be continuously agitated until it is delivered on site. The Contractor shall ensure that no further water is added after water added in the preparation at the mixing plant.

For plant mixed concrete the Contractor shall check that the delivery note for each truck shows:

1. Volume of concrete in m³
2. Cement in kg per m³ of mixed concrete
3. Grade of the concrete
4. Initial setting time with or without hardener
5. Type and quantity of admixture added per m³ of mixed concrete
6. The maximum allowable time interval between the completion of discharge and the mixing of water at the mixing plant

This time interval should be 30 minutes less than the initial setting time of the cement. Any concrete which is not placed in its final position within this time interval should not be used.

The concrete delivery note showing the above information should be signed by approved qualified/experienced supervisors, one at the plant before departure of truck and another one on site before the truck is discharged.

Sample of workscube shall be taken by the Main Contractor at the place where concrete is finally placed in the structural members at the rate specified in Article below.

5.4.12 Quality Control of Concrete Production

a) Sampling
For each class of concrete in production at each plant for use in the permanent works, samples of concrete shall be taken at the point of mixing and /or of deposition as instructed by the Engineer, and in the presence of a representative of the Engineer, all in accordance with the sampling procedures described in BS 1881 and with further requirements set out below.

Six 150 mm cubes shall be made from each sample and shall be cured and tested all in accordance with BS 1881, two at 7 days and two others at 28 days.
At least one sample should be taken of each grade of concrete on each day that concrete is placed. The actual rate of sampling shall be increased for critical elements if instructed by the Engineer.

b) Testing
The consistency of all concrete shall be determined by means of the slump test in accordance with British Standard Specifications No. 1881 "Methods of testing Concrete". The Contractor shall provide the necessary number of slump cones and rods as required by the Engineer.

5.4.13 Failure to comply with requirements

a) Quantity of concrete represented by strength results
The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches. Similarly, the first two or three results shall be taken as representing all the intervening batches. For the individual test result requirements given in Table 2.09A, only the particular batch from which the sample was taken shall be at risk.

b) The Contractor shall take any action instructed by the Engineer to remedy concrete which does not comply with the specification. The results of such actions do not nullify the previous establishment of non-compliance with the specification based on requirements for cube test results. The Contractor shall be responsible for all costs and delays for such actions. Such action may include but is not necessary confined to the following:

i) Increasing the frequency of sampling until control is again established.

ii) Cutting test cores from the concrete and testing in accordance with BS 1881.
iii) Carrying out strengthening or other remedial work to the concrete where possible or appropriate.
iv) Removing the failed concrete.
v) Carrying out non-destructive testing such as load tests on beams.

5.4.14 Mixing concrete

Before any plan for batching, mixing, transporting, placing, compacting and finishing concrete is ordered or delivered to site, the Contractor shall submit to the Engineer for approval full details of all the plant which he proposes to use and the arrangements he proposes to make, including qualified/experienced technical personnel separately for supervision of these activities.

Concrete for the permanent works shall be batched and mixed in one or more central plants unless the Engineer agrees to some other arrangement.

Mixer shall be of a capacity sufficient to take two whole bags of cement per mix. Smaller size mixer shall not be used. Weigh batching machines with water measuring device shall be of an approved type and shall be properly maintained and checked weekly for its accuracy. All materials shall be thoroughly mixed dry before the water is added and the mixing of each batch shall continue for a period of not less than two minutes after the water has been added and until there is a uniform distribution of the materials and the mass is uniform in colour.

The entire contents of the mixer drum shall be discharged before recharging. The volume of mixed materials shall not exceed the rated capacity of the mixer. Whenever the mixer is started, 10% extra cement shall be added to the first batch and no extra payment will be made on this account.

5.4.15 Conveying

The concrete should be mixed as near to the place it is required as is practicable to avoid rehandling and only as much as is required for a specific section of the work shall be mixed at one time, such section being commenced and finished in one operation without delay. All concrete must be efficiently handled and used in the works without twenty (20) minutes of mixing. It shall be discharged from the mixer direct either into receptacles or barrows and shall be distributed by approved means which do not cause segregation and loss of ingredients or otherwise impair the quality of the concrete. Approved mechanical means of handling will be encouraged, but the use of chutes for placing concrete is permitted provided they are not longer than 6m and their slope do not exceed 1 vertical to 2 horizontal and is not less than 1 vertical to 3 horizontal. Conveying of concreting by hand-buckets or similar shall not be allowed. Similarly conveying of concrete by belt conveyor shall not be allowed.

Pumped concrete – coarse aggregate size shall be limited to 20mm for pumped concrete mixes. The slump of concrete discharged into the pump may exceed the specific slump by the amount of slump loss in the pumping system up to a minimum 25mm. the slump loss

shall be the difference between slump tests made at both ends of the pumping system. If the tests indicate a loss greater than 25mm, the Contractor shall modify the pumping system as required to reduce the slump loss to 25mm or less.

A superplasticiser should preferably be used in the pump concrete. The slump of the concrete mix shall not exceed 75mm before addition of superplasticiser.

5.4.16 Depositing of Concrete

Placing of concrete in supported elements, e.g. slab, beam shall not be started until the concrete previously placed in top parts not exceeding 300mm depth below the bottom of the beam/slab of columns is no longer plastic and has been in place at least for two hours.

Concrete shall be placed from height not exceeding 1.5m directly into its permanent position and shall not be worked along the shutters to that position. Unless otherwise approved, concrete shall be placed in a single operation to the full thickness of slabs with beams and similar members. The engineers shall allow concrete to be placed for wall exceeding 150mm thickness from a height up to 3m and in layer not exceeding 750mm if ACROW or other approved system of formwork is used.

In addition, Contractor will ensure that the concrete shall be deposited continuously such that no concrete shall be deposited on concrete which has hardened sufficiently to cause the formation of seams or places of weakness within the section. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic.

Concrete in columns may be placed to a height of 3 m with careful placing and vibration to achieve satisfactory results. Where the height of the column exceeds 3m suitable openings to engineer's approval must be left in the shutters so that this maximum lift is not exceeded.

Concrete shall be placed continuously until completion of the part of the work between construction joints as specified hereinafter in article 2.25 or of a part of approved extent. At the completion of a specified or approved part construction joint of the form and in the positions hereinafter specified shall be made.

5.4.17 Placing Concrete under water

Concrete shall be deposited under water by an approved method e.g. tremie concreting in such a way that the fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at the surface of the concrete.

5.4.18 Precautions of mixing and placing

Any accumulation of set concrete on the reinforcement shall be removed by wire brushing and the area is cleaned thoroughly before further concrete is placed. The Contractor shall provide runways well supported on metal sands for concreting to the satisfaction of the Engineer. Under no circumstances will runways supports be allowed to rest on the reinforcement. Overnight before concreting, the foamwork and reinforcement shall be

thoroughly wetted with clean water and it is again lightly wetted just before concrete is deposited.

Care shall be taken that the concrete is not disturbed or subjected to vibrations and shocks during the setting period.

Mixing machines, platforms and barrows shall be cleaned before commencing mixing and be cleaned on every cessation of work.

Where concrete is laid on hardcore, concrete blocks or other absorbent materials of the base shall be suitably and sufficiently wetted before the concrete is deposited.

5.4.19 Compaction of concrete

At all times during which concrete is being placed, the Contractor shall provide adequate trained and experienced labour to ensure that the concrete is compacted in the forms to the satisfaction of the Engineer.

Concrete shall be placed neither at a rate greater than will permit satisfactory compaction nor to a depth greater than 750mm before it is compacted.

5.4.20 Vibration of concrete

During and immediately after placing, the concrete shall be thoroughly compacted by means of continuous tamping, spading, slicing, rodding, forking and vibration. Vibration is required for all concrete of grades with 28 days strength greater than 15 N/mm².

Care shall be taken to fill every part of the forms, to work the concrete under and around the reinforcement without displacing it and to avoid disturbing recently placed concrete which has begun to set. Any water accumulating on the surface of newly placed concrete shall be removed and no further concrete shall be placed thereon until such water is removed.

i) Internal Vibrators

Internal vibrators shall have a frequency of not less than 7 000 cyles per minute. Such vibrators shall visibly affect the concrete within a radius of 225mm from the vibrator.

Vibrator shall not be used to move concrete from place to place in the formwork.

At least one internal vibrator shall be operated for every two cubic metres of concrete placed per hour and at least one spare vibrator shall be maintained on site in case of break down during concreting operations.

ii) External vibrators

External formwork vibrators shall be of the high frequency low amplitude type applied with the principal direction of vibration in the horizontal place. They shall be attached directly to the forms at no more than 1.2m centres.

In addition to internal and external vibration the upper surface of the suspended floor slabs shall be levelled with manual tamping or vibrating elements prior to finishing. Vibrating elements shall be of the low frequency high amplitude type operating at a speed of not less than 3000 r.p.m.

5.4.21 Curing and Protection

Care must be taken that no concrete becomes prematurely dry and fresh concrete must be carefully protected within two hours of placing from rain, sun and wind by means of hessian sacking, polythene sheeting or other approved means. This protective layer and the concrete itself must be kept continuously wet for at least three days for members less than 300mm thickness and 6 days for members greater than 300 mm thickness after the concrete has been placed. The Contractor must allow for the complete covering of all fresh concrete for a period of three days.

Hessian or polythene sheeting shall be in the maximum widths obtainable and shall be secured against wind. The Contractor will not be permitted to use old cement bags, hessian or other material in small pieces. When temperature exceeds 30°C the new concrete shall be covered with a layer of drip dry hessian.

Traffic or loading shall not be allowed on the new concrete except with the written permission of the Engineer.

When curing compound or membrane are used, full details of the manufacturer's literature and test certificate from the independent testing laboratory should be submitted to the Engineer. The curing compound should have an efficiency index of not less than 90% when tested in accordance with BS 7542. SIKA Top 71 or approved equivalent, without diluting, curing compound shall be applied strictlyin accordance with the manufacturer's recommendations. The floor slab shall not be cured by curing compound but by ponding of water for at least three days or 6 days as specified above.

The method of monitoring the application rate and the area to which curing compound has been applied shall be submitted by the Contractor for Engineer's approval and the approved method shall be strictly followed by the Contractor. The engineer shall, at his discretion, require the Contractor without claiming extra cost to adopt an effective alternative means of curing any area of the structure where curing compound or membrane curing is unsatisfactory in the opinion of the Engineer.

5.4.22 Faulty Concrete

Any concrete which fails to comply with these preambles, or which shows signs of setting before it has been placed shall be taken out and removed from site. Where concrete is found to be defective by the Engineer after it has set, the concrete shall be cut out and replaced in accordance with the Engineer's instructions. On no account shall any faulty, honeycombed, or cracked or otherwise defective concrete be repaired or patched until the Engineer has made

an inspection and issued instruction for the repair. The whole of the cost whatsoever, which may be occasioned by the need to remove faulty concrete shall be borne by the Contractor.

Construction Joints

1. Position of construction joints

   Construction joints shall be permitted only at the locations shown on the drawings or as instructed by the site Engineer. In general, they shall be perpendicular to the lines of principal stress and shall be located at points of minimum shear, viz. vertically at, or near, midspans of slab ribs and beams.

   Where construction joints are not shown on drawings, the Contractor shall submit the plan of floor layout, column and wall elevations showing the construction joints to comply with all requirements of this Article and seek the Engineer's written approval immediately on or before fixing reinforcement. The Contractor shall keep record of position and details of all construction joints and submit to the Engineer within a week of completion the drawing showing them.

2. Maximum distance between construction joint

   Suspended slabs are generally to be cast using alternative bays not exceeding a length of 12m. At least 48 hours shall elapse between the casting of adjacent bays. Joints between bays shall be in positions to be agreed with Engineer. Beams shall be cast with the slab.

   Mass concrete shall be cast in alternate bays in lengths not exceeding 7.5m and in depth not exceeding 1.5m. Adjacent sections shall not be cast within 48 hours of each other. Ground floor slab on hardcore shall be cast in alternate bays not exceeding 4.0m in length and/or width, unless otherwise shown on the drawings. At least 48 hours shall elapse between the casting of adjacent bays.

   Under no circumstances shall concrete be allowed to tail off, but shall be deposited against stopping-boards.

3. Preparation of Construction joints

   Before placing new concrete against new concrete already set, the face of the old concrete shall be thoroughly hacked or roughened to expose the course aggregate without damaging the edges of the concrete. Edges of concrete if damaged shall be repaired with Epoxy Mortar of approved quality. The surface shall be cleaned, laitance and loose material removed therefrom. Immediately before placing the new concrete the surface shall be saturated with water. All construction joints of roof, external walls and columns; and external beams shall be treated with epoxy resin in accordance with the manufacturer's instruction by an experienced skilled worker.

Main Contractor shall ensure that full watertightness of external construction joints is achieved.

Before the final set of the concrete, the construction joint at its top shall be made good with surface trowelling.

4. Reinforcement across Construction joints

At construction joints in slabs, minimum reinforcement of 0.15% of the cross section of the slab should be provided o each face of the slab unless otherwise as detailed shown by the Engineer.

Prices for concrete shall include for construction joints.

5.4.23 Expansion/Contraction joint

Joint fillers shall be flexcell except where high density styropor is shown on the drawing. Sealants shall be Elastometric of an approved type unless otherwise shown on the drawings. Reinforcement or other embedded items bonded to the concrete shall not extend through any expansion/contraction joint.

External peripheral strip of the joint fillers shall be sawn and fixed so that it can be removed easily to form correct and true depth and width of the sealants. Unless otherwise shown on the drawing the depth of the sealants shall be equal to the width of the expansion joint.

The gap for sealants shall be cleared of any mortar and foreign material. The edges of concrete on the sides of the expansion joint shall be protected from breaking. Broken edges shall be repaired with Epoxy Mortar of approved quality such that the width and the line of the expansion joint is perfectly maintained.

The elastometric sealants shall be applied after the application of approved separating membrane and the primer all as per manufacturer's specification.

5.4.24 Waterbars

1. Type

Waterbars shall be PVC waterbars to British Standards 2782 Part 3 and of an approved type, shape and size (min 240mm wide where not shown) shall be provided in the positions indicated on the drawings. At places galvanized m.s. strip of minimum thickness 1.0mm in corrugated shape and of 300 mm minimum width in the following properties i.e. can be used as waterbar, pvc waterbars where shown as such i.e.

- Tensile strength min 12.5 N/mm²
- Elongation at break 300%

- Hardness
- And resistant to aggressive water, diluted acids, moderate alkalis and salt etc.

2. Joints

Joints shall be continuously heat welded in accordance with the manufacturer's instructions. Where the waterbar is to be fixed vertically, metal clips as manufactured by the Contractor of the water bar or of other approved design shall be provided to suspend the waterbar from the reinforcement.

3. Additional waterbar

The Contractor shall adhere strictly to the position and type of construction joints as specified or detailed on the drawings. Any deviation from this procedure or the provision of additional construction joints will require the prior approval of the Engineer and any additional waterbars which may be required will be at the Contractor's expense.

4. Formwork to Waterbar

Formwork shall be designed with sufficient timber formers and blocking pieces to support the waterbar and to ensure that is not displaced during concreting. In vertical walling and similar members the formwork shall be so constructed as to permit the kicker or upstand of concrete surrounding the lower half of the waterbar to be poured in the same operation as the slab or other member from which it springs.

Formwork to walls or similar members where a waterbar is positioned at the base ofthe lift shall have sufficient openings not less than 300mm square at approximately 225mm above the level of the waterbar to permit checking that the waterbar is correctly positioned and not displaced during concreting.

No concreting to a member will be approved where kicker or upstand forms its integral part, until the formwork to the upstand is fixed and the waterbar position is secured.

5.4.25 Formwork

a) Material and design

Formwork shall be constructed of timber or steel or precast concrete or other approved material with sufficient strength to withstand pressure resulting from placing and vibration of the concrete and with rigidity to achieve the specified tolerances.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor.

The formwork shall be designed for the loads, lateral pressure, pressure due to cyclonic winds and other loads likely to be encountered on site.

Shop drawings for formwork including the location of shoring and reshoring shall be submitted for approval by the Engineer before erection. As and when requested by the Engineer, the calculations for the design of formwork will be submitted for approval by the Engineer before erection.

b) Construction

All formwork shall have joints close enough to prevent leakage of liquid from the concrete and formwork shall be jacked or wedged and clamped or bolted to permit adjustments before concreting and to permit easing and removal without jarring of concrete. Formwork shall be securely braced and strutted against lateral deflections and vertical movements. Where formwork is supported on previously constructed portions of the reinforced concrete structural frame, the Contractor shall by consultation with the Engineer ensure that the supporting concrete structure is capable of carrying load and/or is sufficiently propped from lower floors or portions of the frame to permit the load to be temporarily carried during construction. Formwork shall be cambered by the Contractor to the amount approved by the Engineer to compensate for anticipated deflections prior to hardening of the concrete. Unless where shown/directed otherwise, the amount of camber to be 1/500 of the span; e.g. for 10m span camber to be provided is 20mm.

c) Preparation for concreting

The Contractor's attention is drawn to the various surfaces textures and applied finishes required and the faces of the formwork next to the concrete must be of such material and construction and be sufficiently true to provide a concrete surface which will in each particular case permit the specified surface treatment or applied finish.

At construction joints contact surface of the form for surfaces shall overlap minimum 300 mm and shall be held tight against the hardened concrete to prevent offsets or loss of mortar.

Methods of fixing and positioning of the formwork which results in holes through the concrete and/or left in metal ties or similar in the concrete shall require the Engineer's approval.

All surfaces which will be in contact with the concrete shall be oiled or greased to prevent adhesion of mortar.

Surplus moisture shall be removed from the forms prior to placing of the concrete. For surfaces to receive waterproofing membrane, an approved water based mould

oil compatible with the specified waterproofing materials shall be used. For fair-face concrete to receive paint, an approved mould oil compatible with paint shall be used.

Temporary openings shall be provided at the bases of the columns, wall and beam forms and at any points where necessary to facilitate cleaning and inspection immediately before the pouring of concrete.

Before the concrete is placed, the shuttering shall be trued-up, and the interior of the form shall be completely cleared of all extraneous materials including accumulated water.

The reinforcement shall then be inspected for accuracy of fixing. Immediately before placing the concrete the formwork shall be well wetted and inspection openings shall be closed.

d) Defective formwork

Defective formwork shall be removed or strengthened and improved by the Contractor according to the instructions by the Engineer at the Contractor's own cost.

e) Formwork to construction joints, etc

Formwork forming the construction joints and expansion joint shall be rigid, tight to avoid loss of mortar and true in square.

Formwork shall be inspected and approved by the Engineer before placing reinforcement unless previously agreed with the engineer, then it will be inspected along with the inspection of reinforcement prior to concreting.

Notes:
The Contractor shall be deemed to have inspected and examined the site and its surroundings and information available in connection therewith and to have satisfied himself before submitting his tender, as to:-

a) The form and nature thereof, including the sub-surface conditions,
b) The hydrological, geological and climatic conditions,
c) The extent and nature of work and materials necessary for the design, execution and completion of the works and the remedying of any defects therein, and
d) The means of access to the site and the accommodation as may be 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 tender.
e) The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and any document provided by the Employer.

5.5 Dead Load

Loads of materials and finishes shall be those as given in BS6399 Pt 1 (1984).

5.6 Imposed Load

The Contractor shall be responsible for designing the concrete foundations so as for it to resist the imposed load of all required structures. Calculations for the imposed load shall be performed according to relevant BS.

5.7 Wind Load

Wind loads shall be checked as per the loads specified in BS6399 Pt.2 or those of CP3 Chapter V Pt.2, whereas the basic wind speed will be as per the recommendations of the Technical Note NO.1 of the Mauritius Meteorological Services of May 1994.

The basic wind speed shall be 280 Km/hr as a mean value of recurrence of extreme 3 sec gusts for a return period of 50 years and are valid for normal exposures in residential areas. In any case, the design should comply with latest regulations on wind speed.

5.8 Earth Loads

An Assessment of bearing capacity is included in the soil investigation report and the successful Contractor shall design sizing of footings accordingly.

The recommendations of BS8004 "Code of Practice for Foundations" shall be adopted throughout.

5.9 Structural Design

Structural Design shall be carried out in accordance with the relevant British Codes of Practice and Mauritius Standards, which apart from those mentioned above, shall include the following, viz:-

BS8110 – Reinforced Concrete
BS5950 –Structural Steelwork
BS 5400 – Steel, Concrete and Composite Bridges
MS10 – Reinforcement

Note:

- All foundations shall be laid on firm soil.
- The buildings shall be designed as frame structures.

- The buildings and openings shall be designed to resist wind gust of 280 km/h for 3 seconds
- Concrete grade 30 shall be used for all concrete structures

For all concrete works:

- Cover against earth surface – 75mm
- Cover against formwork or blinding in concrete bases – 50mm
- Cover against formwork for other concrete structures – 35 mm
- Cover against formwork in building slabs – 30mm
- For any concrete casting, 6 nos. cubes shall be taken and cube tests results at 7 and 28 days shall be provided. The tests shall be carried out by an independent institution.

5.10 Materials for the Works

- All materials supplied by the Contractor shall comply with the appropriate standard specification unless otherwise required hereinafter.
- Application of compounds shall be carried out strictly in accordance with Manufacturer's specifications.
- All safety measures with respect of storage and application in accordance with the Manufacturer's specifications shall be exercised.

5.11 Rejected Materials and Defective Work.

Materials or work, which in the opinion of the Engineer, do not comply with the specification, shall be classified as rejected materials or defective work and shall be cut out and removed from the works and replaced as directed by the Engineer.

5.12 Architectural Design

The Architect shall design the following:

5.12.1 Building Works

Building works shall consist of the following

- Construction of a Switchgear Room, Store, control room, Site Works
- Access roads and their drainage system within the plots and all around the plots
- Access roads and their drainage system to provide access to the two Solar Compact Station
- Access track roads as shown in Drawing S-5191
  Retention wall behind the new Building and associated drainage system
- Cable trenches and ducts
- Any other associated ancillary building and site work

5.12.2 Schedule of Architectural Services

- Design the buildings (aesthetically) and provide drawings for the buildings and the site works
- Provision of signature to the Construction Contract drawings.
- The Architect shall be required to issue to the Employer signed and stamped drawings in both hard copy (three sets for application of building permit and two sets of tender drawings) and soft copy.
- The Architect shall also issue any other drawings that may be required e.g. Site plan, Elevations and Cross sections etc.
- The Architect should also cater for the following:

    a) Schedule of finishes
    b) Schedule of openings
    c) Site works to include drainage system, access roads, among others
    d) Specifications of materials for the execution of works

- The Architect shall provide information required for statutory applications under planning and building acts and any other statutory requirements under building acts, regulations or other statutory requirements.

5.13 Access Roads

The different types of access roads as shown in drawing S-5191 are enlisted below:

1. Track roads
   This track road shall be at least 3m and 5m wide, shall consist of stoning and kerbs on both sides and shall be accessible to vehicles.

2. Asphalted road
   Contractor to refurbish the existing asphalted road as from the existing building and to extend same up to the fencing. The existing and extended part shall be provided with kerbs.

5.13.1 Tarmac

- Remove 350mm thick top soil.
- Compact surface with a ten ton roller to 95% BS heavy to receive hardcore base.
- Supply and lay 200mm thick hardcore filling and compact with a 10 -Ton roller to receive crusher run.
- Supply and lay crusher run (0/20) in layer of 150mm and compact with a 10 tons roller to 95% BS heavy to achieve a final compacted layer of at least 150mm thick. (Compaction tests shall be carried out)
- Clean off surface of crusher run and apply prime coat.
- Supply, lay, roll and compact to 95% BS heavy a minimum of 60mm thick premix asphaltic concrete grade (0/10) to falls and crossfalls as required.

- Road surfacing shall meet local fire and emergency vehicle access requirements.

5.13.2 Stoning

- Remove 300mm thick top soil.
- Compact surface with a ten ton roller to 95% BS heavy to receive hardcore base.
- Supply and lay 200mm thick hardcore filling of 75-100 mm size and compact with a 10 -Ton roller to receive blue basalt aggregate.
- Supply and lay100mm thick (or as directed on site) 25-40mm clear dust free blue basalt aggregate spread on surface to a neat flat surface over the whole surface of the access roads in between the concrete kerbs.
- Appropriate drainage system of the pathways shall be provided to ensure rain water absorption into the ground.

5.13.3 Concrete kerbs

The concrete kerbs shall be precast and of size 380x150x900mm long. Works shall include all necessary excavation, concrete footing, hunching up on both sides. Necessary earthwork support, strutting and shoring to sides of excavations shall be allowed for.

5.14 Drainage System

Appropriate drainage system of the whole site inclusive of pathways and access roads shall be designed and provided so that there is no accumulation of water.

5.15 Cable trenches/ducts / drawpits

Design and provide cable trenches/Reinforced concrete ducts/reinforced concrete drawpits as required. Works shall include excavation and backfilling with appropriate materials, compaction, compaction tests and warning slabs, among others. The cable trenches and shall be as per Drawings 6549-17 and 6550-17.

5.16 All Buildings finishes

5.16.1 Rendering

Allow for the provision of 20mm thick external rendering to general surfaces of blockwall/concrete wall /above roof level including surfaces of attached and projecting column, isolated column, coping, cills, beams, soffit in narrow widths and reveals, finished to receive antifungus paint.

Allow for the provision of 12 mm rendering to soffit of slab finished to receive antifungus paint.

The render shall be made up of cement and rocksand (1:4) mixed with an approved quality plasticizer on the surfaces, if directed. Rate shall include for hacking and labour for forming arises and fair edges etc. as per specification.

5.16.2 Ironmongeries

Supply and fix the required ironmongeries which shall be of the quality and design specified or other approved equivalent. All ironmongeries shall be fixed strictly as per manufacturer's specification and to Architect's approval.

5.16.3 Metal Doors

Supply and fix new Metal doors (single leaf, double leaf or louvered) as per schedule of openings.

The door frames shall consist of 65 x 40 mm hot dipped galvanized angle bars.

The metal doors shall be made of 65x40 mm square hollow sections at the same interval. This frame shall be hot-dipped galvanized.

3 mm thick galvanised metal sheet shall be provided on both sides of the 65x40 SHS frame.

The doors shall be thoroughly cleaned of all scale, rust particles, dirt and grease by scrappers and wire brushes or other method. Treat with one coat of two-pack primer and spray paint with hard gloss enamel paint, to the satisfaction of the Engineer or representative. Colour to be to the Engineer's approval.

The doors shall be provided with good quality heavy duty handles, good quality hinges and locksets complete with all necessary fittings and accessories. Samples should be provided for approval prior to fixing.

Prior approval shall be sought for the Ironmongeries.

5.16.4 Door Stop

Supply and fix rubber and aluminium bodied floor /wall stop of approved type from 'DORMA' for all doors.

5.16.5 Door Closer

Allow for the supply and fixing of door closers type 'DORMA TS83' with hold open delayed closing option to all doors.

Note: Doors shall be as per the schedule of openings and Architect's approval and specification.

5.16.6 Painting Procedure

The following painting proedures shall be applied:

a) Concrete Surface

Prepare and apply one coat of undercoat and at least three finishing coats of high quality antifungus paint to MS3 standard on the internal and external surfaces of the building.

Surface preparation and paint application shall be done strictly as per Manufacturer's recommendation/s and specifications. Colour shall be to Architect's approval.

Paint can be applied by conventional brush or rollers. The coating must be neat and smooth just after application. The application of coating materials shall be carried out in a neat workmanlike manner by skilled personnel.

b) Metal Surfaces

All metal surfaces to be thoroughly cleaned of all scale, rust particles, dirt and grease by scrapers and wire brushes or other method. Treat with one coat of two-pack primer, one coat of undercoat and paint with hard gloss enamel paint, to the satisfaction of the Engineer or representative.

c) Epoxy Flooring

- Allow for the Epoxy painting of the switchgear and transformer rooms and as and where applicable.
- Allow for the cleaning of the floor surface free from traces of oil, dirt and any trace of paint to receive new epoxy painting.
- Paint the floor with one coat of approved epoxy primer followed by at least two coats of approved epoxy paint (‘Hi-built’ or similar), to the satisfaction of the Engineer.

Notes

i) Coating shall not be applied to surfaces upon which there is any moisture, or during rain or misty weather without suitable protection. Each coat shall be protected during initial curing period against possibility of moisture condensation or contamination with foreign matter.

ii) All coated areas which are defective or damaged, shall be cleaned and repaired. Coating that are loose, weakly bonded, blistered, abraded or otherwise defective

shall be removed and the surface re-cleaned. The surface shall then be re-coated in accordance with the appropriate clause in this specification.

5.16.7 Sanitary wares

Rates in this section are to include for supply and fixing of UPVC pipes, bends, ties, appliances, valves, all fittings, acid resistant bottletrap, chromium plated taps, brackets, flush pipe supports and the like, connection to the main water pipe and septic tank.
Supply and fix 1 Nos. 'Armitage Shanks' or similar approved washdown WC unit cistern 4.5 litres capacity, overflow and freeflow, plastic siphon fittings, ½ inch flush button, supply ball valve, isovalve, servicing valve, plastic flush bend, plastic seat and cover P and S trap and all other necessary fittings and ancillaries.
Supply and fix 1 Nos stainless steel toilet paper holder with vandal proof holder approx. dimensions 150 x 80 mm.
Supply and lay 50mm diameter waste pipe including Tee, bends and the like.
Allow for the supply and fixing of approved nozzles near toilet bowl with flexible water cable and angle valve complete with all necessary fittings and accessories and connection to the existing water reticulation network and waste disposal system.
Allow for the provision of floor sumps in the toilet areas, in each toilet.
Supply and fix semi recessed soap holder in vitreous china
Supply and fix good quality edge mirror fixed with round headed chrome plated screws on 6mm plywood backing 600mm x 600mm

5.16.8 Waterproofing to roof slabs

A. Allow for new waterproofing works to roof slab of the building inclusive of all parapet walls and the guard house roof as per details below: New Screed

Lay new screed made up of cement sand mortar and mixed with Jaycocrete or similar products to falls and cross-falls to a slope of 1:100 on roof, in accordance with the manufacturer's specifications. Slope direction should be according to location of rain water pipes.

Exact dimensions to be taken on site.

Screed to be cast using ready mix screed complete with Jaycocrete or similar products and placed using mechanical concrete pump.

Height of up stands at the edge of roof slab to be increased if the height is reduced below 75mm after placing new screed (if applicable).

B. Waterproofing Membrane

Supply and lay 5 mm thick approved new waterproofing membrane, as per specifications, in double layer with granular finish or alternative polymeric membrane on roof slab, parapet walls and slab edges, as directed on site and as per manufacturer's details and

specifications, including all necessary primer, tack-coat, overlapping (measured- net) and tucking into groove.

Exact dimensions to be taken on site.

Contractor shall submit manufacturer's specifications, sample for approval and certificate of guarantee of 10 years from the local supplier together with the bid.

C. Tests on Completion

a) No-Ponding test
The Contractor shall carry out a No-Ponding Test, to the Engineer's approval, after the laying of the new screed.

b) 24-hour No-Leak Test
The Contractor shall carry out a 24-hour No-Leak Test, to the Engineer's approval, after the application of the new waterproofing treatment, to verify for any leakage.

D. Rain water pipes

Allow for the provision of 5 nos. (or as directed) new PVC rain water pipes 75 mm diameter with plastic clamps at every 1m as directed on site.

E. Specifications

E.1 Waterproofing System

Performance Specifications of the waterproofing system

- The system shall, unless specified otherwise, be resistant to foot traffic and light concentrated loads associated with installation and maintenance operations.
- The system shall comply with European, South African or American standards.
- The system and its installation shall conform strictly to the Manufacturer's specifications.

E.2 Preparation of surface to receive Waterproofing treatment

The waterproofing Contractor shall ensure that the slope of the slab is adequate to prevent water ponding and is according to Manufacturer's specifications.

All concrete surfaces to be waterproofed shall be reasonably smooth and free from holes and projections, which might puncture or otherwise damage the waterproofing treatment to be applied.

The surface of the substrate shall also be dry and shall be thoroughly cleaned of dust and loose materials prior to the laying of the waterproofing system

Prior to the application of the new treatment, the waterproofing Contractor shall be required to issue a certificate stating that the surface is ready to receive the new waterproofing treatment and is according to the Manufacturer's Specifications.

It is hereby made clear that, should the waterproofing system fail to perform as required, no discharge of responsibilities shall be allowed on the grounds of the existing conditions prior to the application of the waterproofing system.

E.3 Inspection of Waterproofing Treatment

The waterproofing treatment shall be carried out to the satisfaction of the Engineer.

The Contractor shall ensure that the waterproofing treatment is free from wrinkles, buckles, blisters (trapped air) and other damage. Any damaged or defects to the waterproofing system shall be corrected at the Contractor's cost, and to the Engineer's approval.

The Contractor shall clean adjacent surfaces of spillage and spattering of any adhesive materials used in the works

E.4 Water Test

The Contractor shall carry out a no-ponding test, to be carried out after the laying of the new screed, and which shall be to the Engineer's approval

The contractor shall carry out a 24 hours water test to be carried out after laying of new waterproofing membrane to verify for any leakage. The test shall be to the Engineer's approval.

E.5 Guarantee Certificate

On satisfactory completion of the waterproofing works, the Contractor shall submit a certificate of guarantee against leakage, defective materials and defective installation of the completed waterproofing system. Any such defects or leakage occurring during the guarantee period shall be promptly and completely attended to, including all affected work, at no additional cost to the Employer

The said guarantee shall be in effect for a period of ten (10) years from the date of the Practical Completion Certificate. The guarantee shall be signed by the Contractor and shall be submitted to the Employer.

5.17 Site clearance and Professional Cleaning at the end of all works

Allow for the provision of professional cleaning services at the end of all works. The whole building, the openings and all the finishes as well as the yard shall be thoroughly cleaned**.**

The Contractor shall abide to the following conditions:

1. The Contractor shall remove all debris, surplus materials from site as they accumulate and at completion. Clean all surfaces internally and externally. Remove stains and touch up paint to the satisfaction of the Employer.
2. The Contractor must ensure that the method and equipment used do not cause any damage to CEB's plant and equipment and vehicles parked in the yard. Approved scaffolding must be erected to ensure safety on site
3. The Contractor shall abide by the Occupational Safety, Health & Welfare Act of 2005.
4. No part of the works shall be covered up or put out of view without the approval of the Engineer and the contractor shall afford full opportunity for the Engineer to examine any such part of the works which is about to be put out of view.
5. The Contractor shall provide all necessary plant, general tools, scaffolding materials and labour for the prompt and efficient execution of the works. Moreover, the Contractor shall provide all the proper safety gears to their personnel on site.
6. Materials, goods and workmanship shall be of the best quality of their respective kinds, and those for which there is a Mauritian Standard, a British Standard or Code of Practice (referred to herein as MS, BS and COP) respectively shall comply therewith unless otherwise stated.

7. The Contractor at his own cost, for the CEB's approval shall supply samples of all materials. Once approved no other material shall be used without the permission of the CEB.

8. The Contractor shall, with due care and diligence, execute and complete the works and remedy any defects therein in accordance with the provisions in the Contract. The contractor shall provide all superintendence, labour, materials, plant, and all other things, whether of a temporary or permanent nature, required in and for execution, completion and remedying of any defects to the satisfaction of the Civil Engineer. The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction.

9. The Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the contract to the satisfaction of the Engineer. The Contractor shall comply with and adhere strictly to the Engineers instruction on any matter, whether mentioned in the Contract or not, touching or concerning the Works. Materials or work, which in the opinion of the Engineer, do not comply with the specification, shall be classified as rejected materials or defective work and shall be cut out and removed from the works and replaced as directed by the Engineer.

10. Plant & materials

    The Contractor shall provide all necessary plant, general tools, scaffolding materials and labor for the prompt and efficient execution of the works. Moreover, the Contractor shall provide all the proper safety gears to their personnel on site and necessary facilities such as toilets, bathrooms etc. for his personnel.

11. Foreman

    A competent general foreman shall be always present on site during working hours and any instruction given to him by CEB Engineers shall be deemed to be given to the Contractor.

5.18 Materials Specifications

5.18.1 Quality of Materials

a) General

All materials used in the Works shall be of the qualities and kinds specified and shall be approved by the Engineer. They shall comply with the requirements of the British Standards (hereinafter abbreviated to OS) published by the British Standards Institution, or A.A.S.H.O. and ASTM Specifications as specified elsewhere in the Specifications. All materials may be checked both at the source and on site and approval of any material at its source does not necessarily imply that it will be approved on site.

All materials shall be delivered on to the site in sufficient period before they are required for use in the works, so that such samples as the Engineer may wish are taken for testing and approval, and the Contractor shall furnish any information required by the Engineer on the materials.

b) Defective Materials

All materials which do not comply with the requirements of the Specifications will be rejected and all such materials, whether in place or not, shall be immediately removed from the site by the Contractor at his own expense.

c) Order of Materials

The selected Contractor shall place orders for all materials, tools, equipment, and fittings etc. within one week after being allocated the contract. He shall keep the Engineer informed of the order placed and of their expected delivery for use in connection with or in the works.

5.18.2 Handling and Storage of Materials

a) Stockpiling of Aggregates

Approved aggregates shall be delivered to the Site in prescribed sizes or grading and shall be stockpiled on paved areas in separate units.

Special care shall be taken to avoid segregation, contamination and mixing of different classes of aggregates. Stockpiles shall be built by layers about 80 cm high. Material to be loaded shall be taken from the upper layer and never from the toe of

the stockpile. Fine aggregates shall be allowed to drain until uniform moisture content is reached before it is used.

b) Storage of Cement

Cement shall be stored in well ventilated, watertight building with floors raised 30 cm above ground level and no cement shall be within 15 cm of the sides of the buildings to ensure circulation of air. Each consignment shall be kept separately and the Contractor shall use the consignments in the order in which they are delivered on Site. When being conveyed to the site in lorries or other vehicles, they shall be properly covered with tarpaulins or other effective waterproof coverings. Cement, which has become unsuitable through absorption of moisture shall be rejected and removed from the site by the Contractor at his own cost.

c) Storage of Steel Reinforcement

Steel reinforcement shall be stored, sheltered and supported by wooden blocks as to prevent sagging. Bars shall be stored in separate lots according to diameter and quality.

5.19 Engineer's Specification

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified shall be accepted subject to the Employer's Representative's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Employer's Representative at least 28 days prior to the date when the Contractor desires the Employer 's Representative's consent. In the event the Employer's Representative determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

5.20 Blockwork Specification

5.20.1 Concrete Blocks

Concrete cellular blocks shall be obtained from an approved manufacturer and shall have been manufactured in accordance with BS 6073: Part 1: 1981. The blocks sizes are to be 457 x 303 x 150 or 200mm. An average compressive strength from a sample of 10 blocks on

gross area shall be as specified on the drawing. No individual block shall have a compressive strength less than 80% of the specified on gross area. Where compressive strength is not specified, the specified minimum strength will be 3.5 N/mm². Blocks shall be tested in accordance with Appendix B of BS 6073: Part 1. Alternatively testing in accordance with Appendix B of BS 6073: Part 2 may be allowed subject to approval from the Engineer.

5.20.2 Mortar

Cement mortar for laying of blocks shall consist of 1 part of ordinary Portland cement: 3 to 4 parts washed rock sand by weight, materials as specified for the use of concrete and an approved plasticizer in liquid shall be mixed and proportioned as specified by the manufacturer.

The ingredient of the mortar shall be measured by proper gauge boxes, or by weigh batcher. When measured by the gauge boxes, the dry density of the sand shall be taken as 1360 kg/m³ and of cement as 1440 kg/m³. The mixing by hand shall not be permitted. Mixing shall be by an approved mechanical batch mixer of capacity not less than 0.1m³ (finished product).

5.20.3 Setting and jointing

Mortar shall be used within one hour of mixing. The blocks shall be laid in a stretcher bond with 10mm thick joints. The joint shall not vary ±3mm and shall achieve the specified height in specific number of courses shown on the drawings. The work shall be carried out with horizontal joints truly horizontal and level and no part shall be 4 courses above adjacent work during construction. The vertical joint shall be 10mm thick with ±3mm tolerance.

No extra claim of labour and/or material or whatsoever will be allowed by the Employer due to non-availability of specified sizes of concrete blocks. The Contractor shall build to the specified height floor to floor by cutting the concrete block and/or placing extra concrete height of the ring beams. The adjustment of thickness of mortar joint shall not be permitted.

No vertical joint in any courses shall be within 110 mm of a similar joint in the course immediately above or below except where shown otherwise.

A written approval of the design engineering consultants is required by the Contractor for the following:

1. Changes in position of load bearing walls
2. Sizes of structural opening for doors, windows and others
3. Cutting of a vertical chase more than 25 mm wide x 20 mm deep
4. Cutting of a horizontal chase in the wall of length more than 900 mm and depth 20 mm
5. Built in services in wall requiring cutting of the walls
6. Number of length of cutting in walls for conduits, services, etc in excess of 2 of nature mentioned in (4) or (5) above

No pipes carrying hot water shall be embedded in masonry wall. All cutting in the walls for fixings of doors, windows, etc shall be kept minimum, meaning that fixings may be built with courses of masonry. The damaged or displaced block shall have to be removed and made good before concreting ring beam above and/or rendering whichever is earlier at no extra cost to the Employer.

5.20.4 Reinforcement for Blockwork

All external block walls exposed to rain and wind shall be reinforced with brick reinforcement for every 3rd course and will be anchored at ends and bends to r.c wall ties or columns.

The reinforcement at the tee and right angle junctions of masonry with or without r.c. wall tie columns shall be built with the courses of masonry. The r.c. wall tie columns shall be connected in heights not more than 6 courses of masonry along with the masonry. The construction of the r.c. wall tie column will not be permitted ahead of construction of walls. The concrete to the r.c. wall tie column shall be class 25/20 nominal mix with slump not more than 50mm unless otherwise specified on the drawing. The reinforcement to the r.c. wall tie column shall be as shown on the drawings.

Whenever removable panel for future door or window is anticipated, the same will be built with bricks reinforcement at alternate courses and good bonding is ensured to make the joints leak proof.

At the end of each working day of the masonry work, horizontal and vertical joints on both faces shall be rake out 4mm deep with a scraper. Faces of the r.c. wall tie columns and ring beams shall be roughened and hacked with a chisel hammer between 16 hours and 32 hours after they have been concreted. This is essential for proper bond between rendering and walls.

5.20.5 Curing

The completed masonry work shall be cured continuously for 72 hours with water. Curing of masonry works shall start 4 hours after they have been laid.

5.20.6 Load bearing walls

Load bearing wall shall comply with British Standard BS 5628: Part 1: 1992 and BS 5628: Part 2 and 3: 1985 where not inconsistent with these Preambles.

5.20.7 Fixing blocks and leaving holes

Provide and build into walls all necessary fixing blocks and leave out as necessary holes for pipes, conduits and the like and make good after fixing by other trades and specialists as required to the specialist's detail to achieve movement and watertightness.

5.20.8 Build in lugs

Form or leave mortices in walls for, and build in lugs and all necessary fixing for metal windows and doors, door frames and lining, sanitary fittings, rainwater pipes, clips and bearer of various types.

When building up the walls, the openings shall be made as per structural dimensions of the schedule for doors/windows, the frames are placed, complete with lugs, the walling completed in concrete mix type C.

5.20.9 Damp-proof course

Unless and otherwise indicated on drawing provide a layer of 2-ply felt damp-proof course. Felt to be of a manufacture approved by the Engineer and to be laid on a 10mm (minimum) thick bed of cement mortar (1:3) on walls.

The damp-proof courses to stand the full thickness of walls, partitions and beams in one width and to be overlapped 150mm at all jointing and corners.

5.20.10 Measurements

The contractor must allow in his prices for blockwalling for plumbing angles, all straight and raking cutting, cutting and fitting to columns, cutting and pinning to beam, cutting, and fitting around end of cills and lintols, cutting and pinning ends of structural timber.

The rates of blockwork must also include for fixing all door, window and like openings, forming reveals to same and for cutting and waste to walling in short lengths to mullions and jamb of openings.

The rates of blockwork must also include for hoisting and building off beams and slab at any level, all necessary scaffolding and for work built overhead.

5.21 Stripping formwork

Formwork shall be removed without undue vibration or shock and without damage to the concrete.

Contractor should submit concrete test results at 3days/ 7 days and seek the Engineer's approval before the removal of formwork. No formwork shall be removed without the prior consent of the Engineer and the minimum periods that shall elapse

between the placing of the concrete and the striking of the formwork will be as follows:

1.	Beam sides, walls and columns (unloaded)	***24 hours***
2	Slab soffits except of flat slab, shell roof, folded plate construction (with props designed to left under)	***84 hours***
3	Soffits of ribbed slab and hollow block composite floor slab except solid strips (with props designed to left under)	***5 days***
4	Flat slab, shell roof and folded plate construction slab soffit and sides (with props designed to left under)	***10 days***
5	Beam soffits including those of solid strips of hollow block composite floor slabs, waffle slab (with props designed to left under)	***10 days***

If the formwork is not designed for removal of soffits with props left in place, the soffits and props should be left in position until the appropriate period for removal of props given below. (subject to works cubes achieving at 7 days strength equal to 2/3 of specified 28 days strengths and the loads due to constructions on them being lighter than the designed superimposed loads,

1.	Slab soffit except of flat slab, shell roof, folded plate construction	***10 days***
2	Flat slab, shell roof folded plate construction slab soffits and sides	***14 days***
3	Beam soffits including those of solid strips of hollow block composite floor slab, waffle slab	***14 days***

if the contractor wishes to take advantage of the shorter stripping times as permitted above for beam and slab soffits when props are left in place, he must so design his formwork that sufficient props as agreed with the Engineer can remain in their original position without being moved in any way until expiry of the minimum time for removal of props. Stripping and re-propping will not be permitted.

For system of construction of r.c walls by slip forms or similar; the full details of the system of formwork, its rate of travel, method of making good and curing of concrete, method with detailed drawings for reinforcement starters for structural r.c. members to be supported on the r.c. walls and other relevant details to be submitted for the approval by the engineer before commencement of works.

For systems of construction such as prestressing or post-tensioning, stripping of foamwork should be carried out after the concrete attains the requisite strength and after tensioning of tendons, but in no case shall it be less than 72 hours. Contractor shall be responsible for consequent damage arising from early stripping of formwork.

5.22 Making Good

After removal of formwork, all projections, fins, etc., on the concrete surface shall be chipped off, and made good to the requirements of the Engineer. Any voids or honeycombing shall be treated as described in the “Faulty Concrete” section.

5.23 Surfaces finishes from formwork or moulds

- Type A finish

  This finish is obtained by the use of properly designed formwork or moulds of closely-jointed sawn boards. The surfaces will be imprinted with the grain of the sawn boards and their joints. Alternatively, steel or other suitable material may be used for the forms. Small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing, or other large blemishes. Permissible tolerances are to be as per the “tolerances section” of this specification.

  Unless and otherwise shown, this is the finish required for all rendered surfaces after hacking as specified for rendering to Architect’s specifications.

- Type B finish

  The finish is obtained by the use of properly designed forms of closely-jointed wrought boards. The surfaces will be imprinted with the slight grain of the wrought boards and their joints. Alternatively, steel or other suitable material may be used for the forms. Small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing, or other large blemishes. Permissible tolerances are to be same as (1) above. Unless and otherwise shown, this is the finish required for surfaces covered by false ceiling and by metal framework to fix wall cladding etc.

- Type C finish

  This finish can only be achieved by the use of good quality concrete and by using properly designed forms having a hard, smooth surface. The concrete surfaces should be smooth with true, clean arrisses. Only very minor surface blemishes should occur and there should be no staining or discolouration from the release agent.

  Permissible tolerances are to be half of those mentioned in “Tolerances section” of the specification.

  Unless and otherwise shown, this is the finish required for “Fairface” concrete or precast concrete.

- Type D finish

  This finish is obtained by first producing a Type B finish on thoroughly compacted high quality concrete, cast in properly designed forms. The surface is then improved by carefully removing all fins and other projections, thoroughly washing down and then filling the most noticeable surface blemishes with a cement and fine aggregate paste. Every effort should be made to match the colour of the concrete. Care should be taken, in the choice of any release agent used, to ensure that the finished concrete surface is not permanently stained or discoloured.

  Unless and otherwise shown, this is the finish required for “off shutter” concrete where shown without rendering and to remain exposed after painting to architect’s specifications.

- Type E finish

  This finish is obtained by first producing a Type C finish and then, while the concrete is still green, filling all surface blemishes with a fresh, specially manufactured and marketed approved cementious paste/slurry coloured or plain to architect’s approval as a base coat and thereafter applying on the same day a finished coat, total thickness to be specified by the architect, finished even and smooth with a steel trowel without any marks. Every effort should be made to match the colour of the concrete. Thereafter the unit is properly cured, the faces rubbed down where necessary, to produce a smooth and even surface. This finish is used only where so specified by the architect for special surfaces.

  A sample for each of the above surface finishes will be made for at least of 10m² area for approval by the Architect and the Engineer. The sample will be used for comparison for acceptance of similar specified finished surfaces.

5.24 Grade of finish of free surfaces

Horizontal or nearly horizontal surfaces which are not cast against formwork shall be finished to the grade shown and/or specified by the Architect. They are defined hereunder.

- Grade U1

  This is a hard smooth steel trowelled surface for use where appearance is important, for laying of finished product with minimum thickness of adhesive and for laying of epoxy thereon.

  To start with, the surface shall be floated as for a U2 finish. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel-trowelled

under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

The tolerances to be achieved for the finished surface when measured should not be more than half of what is specified in “tolerance section (3), (5) and (6).

- Grade U2

  This is a floated finish for roof or floor slabs and other surfaces where a hard steel trowelled surface is not required e.g. for laying waterproofing membrane, pvc tiled floor on adequate thickness of filler/adhesive all to architect’s specification.

  The surface shall first be treated as a class U3 finish and after the concrete has hardened sufficiently, it shall be floated by hand or power floated sufficient only to produce a uniform surface free from marks and thereafter wood floated.

  The tolerances to be achieved for the finished surface when measured should not be more than what is specified.

- Grade U3

  All surfaces on which no higher class of finish is called for on the drawings or instructed by the Engineer shall be given a U3 finish.

  The concrete shall be leveled; all voids filled with concrete, (and screeded where so stated/specified, screed to be monolithic with concrete) to produce a uniform plain or ridged surface without any voids or projecting coarse aggregates, surplus materials being struck off by a straight edge immediately after compaction.

A sample for each of the above grades of finish on Free Surface will be made at least 10.0m² area for approval by the architect and the Engineer. The samples will be used for compaction for acceptance of similar specified finish for the free surface.

Tolerances

1. On all setting out dimensions of 10.0m and over a maximum non-cumulative tolerance of plus or minus 10mm will be allowed, and for those under 10m the allowable maximum non-cumulative tolerance will be plus or minus 5mm

2. On the cross sectional dimensions of structural members, unless otherwise required by the drawings, a maximum tolerance of plus or minus 5mm will be permitted.

3. The top and soffit surface of slabs shall be within 5mm for area less than 40sqm and within 10mm for area 40sqm and above of the

normal levels shown on the drawings. The top of the upstand beam and soffit of downstand beams shall be truly level and line and non-cumulative tolerances of 5mm for length up to 10m and not more than 10mm for full length of the beam exceeding 10m length.

4. Walls and columns shall be truly plumb and non-cumulative tolerance of 10mm in each storey and not more than 20mm out in their height will be permitted.

5. Surface tolerance for slab on grade industrial buildings, warehouses, etc shall be based on a 3m long straight edge which rests in contact with the floor surface. The maximum gap under the straight edge should not exceed 5mm.

6. Where drawings call for tolerance other than those given in the above paragraphs the drawings shall prevail.

7. The contractor shall be responsible for the cost of all corrective measures required by the Engineer to rectify work which is not constructed within the tolerance set out above.

5.25 Composite Floor slabs

5.25.1 Size, type & concrete mix for floor block

Concrete hollow blocks for use in the composite floor slabs are to be size and shape as shown on the drawings with 30 mm wall thickness and are to be adequate strength to support the concrete during placing and consolidation by vibration. Blocks are to be manufactured in accordance with the procedure specified in BS 6073 or MS 42.

No coral sand shall be used in making of concrete blocks. The compressive strength of concrete block on gross area to be not less than 3.5 N/mm² at 28 days.

Concrete blocks are to remain under cover and stored for at least 14 days before use on the site. Concrete blocks are to be well wetted before 12 hours and immediately before concreting.

5.25.2 Composite floor construction

The hollow block floor construction is generally to be as shown on the Engineer's drawing. Care shall be taken in placing blocks to ensure that they are set out in accordance with the details shown on the drawings and that they run truly in line without encroaching on the width of the in-situ ribs and solid strips.

Concrete blocks where shown on the drawings for less than full width e.g. ½ and 1/3 width shall be cut by grinder or manufactured as such. The length of the concrete block where it encroaches the solid strip shall be cut by grinder. Contractor to include cost of the cutting in his prices.

The open ends of hollow blocks adjacent to the concrete to be placed in-situ are to be plugged or stopped previously with concrete 25/20 grade 40 mm thick to prevent the concrete from flowing into the void and the Contractor is to include for this in his prices.

The Contractor should note that slip tiles are not to be used to the soffit of ribs. The formwork shall be for whole area covering the blocks and ribs and he is to take this into consideration in pricing the items of formwork to the soffit of hollow block floor construction.

Before concreting is carried out, the blocks are to be thoroughly wetted. Care should be taken during concreting that the width of ribs between the rows of blocks and of the solid in-situ concrete shown on the drawings adjacent to supporting beams is not encroached upon by the blocks.

The purpose made spacer blocks of approved size is made in mortar of not less than half strength as of specifie0d strength of concrete with grooves and tying wires shall be used to maintain the width of the ribs and positioning of reinforcement. Contractor to include for this in his pricing.

It is required that the concrete for topping is placed along with concrete to the ribs between hollow blocks.

5.25.3 Fixing of rib reinforcement

Reinforcement shall be positioned accurately with required cover in accordance with the drawings and using the particular spacing block with wire ties as previously described. Spacer blocks shall be provided in ribs at no more than 1.2 m centres. Care must be taken during concreting that the reinforcement is not displaced.

5.25.4 Holes for services, etc.

Where holes for services, etc. occur, the necessary holes or openings shall be accommodated by the replacing of a hollow block by in situ concrete or the widening of a rib including extra reinforcement all in accordance with the Engineer's instructions. Prices for holes/openings etc. through hollow block construction are to include the re-arrangement or substitution of the hollow block with solid concrete and reinforcement in addition to the actual formation of the hole.

5.25.5 Embedded items in concrete

All sleeve, insert, anchors and embedded items required for adjoining structural work or for its support shall be approved by the Engineer and shall be placed prior to concreting and shall be used after an interval of time approved by the Engineer.

Electrical conduits shall be of size not exceeding 20mm overall diameter. They shall be placed at least 75 mm apart in the central thickness of the slab and beam. The group (consisting of maximum 3 @ 75 mm each apart) of conduits to space at not less than 2000mm apart. At crossing the conduits should not be more than 2 Nos.vertically. Where

diameter of conduits exceeds 20 mm, a written approval of such drawings showing their exact position and numbers should be obtained from the Engineer. The same applies to insert for electrical sockets, similar fittings into the concrete members.

Specification for electrical conduits for concrete for embedded items and electrical conduits shall apply except (i) no electrical conduits will be placed in the topping less than 70 mm thick and (ii) where conduits are required to be placed in toping, they shall be placed in size not exceeding 20 mm before placing reinforcement to topping i.e. below the reinforcement on top of the concrete blocks.

5.25.6 Notes concerning measurements and pricing concrete work

The contractor must allow for costs incurred during the progress of the Contract for complying with the provisions concerning the preparation and use of specified grades of concrete mixes.

Prices for concrete shall include for mixing and depositing as described or indicated and for hoisting and depositing at the various levels required throughout the building, and shall also include for forming or hacking a satisfactory key for construction joints and for all faces receiving asphalt and plaster work.

Prices for slabs shall also include for leveling of the surface as described under "compaction", and all temporary formwork to form construction joints at bay edges.

Prices for reinforced concrete shall, in addition, include for filling into, between or on formwork and thoroughly compacting between and around rods or fabric reinforcement and for forming all addition construction joints between varying mixes. Where described as vibrated, prices must include for fully vibrating as described.

Formwork (use and waste only) is measured net to the actual face of the concrete to be supported and the prices for formwork shall include for extra material at joints, extra labour and waste for narrow widths, small quantities, overlaps, passings at angles, straight cutting and waste, splayed edges, notchings, etc., and for fixing at the various levels including battens, struts, and supports and for bolting, jacking, wedging, casing, striking and removal. Prices for linear items such as boxings shall include for angles and ends. Strutting has been measured at varying levels to slab soffits only and prices for other items include for strutting at any level.

Prices for steel rod reinforcement shall include for all waste in cutting to lengths and all labour in bending and cranking, forming hooked ends, handling, hoisting and fixing in position and for providing all necessary tying wire and supports, e.g. steel chairs. Prices for fabric reinforcement shall include for all straight cutting and waste, handling, hoisting and fixing in position, providing all necessary tying wire, and supports, e.g. steel chairs and all extra material in laps. Prices for steel rod reinforcement shall include for lengths up to and including 12 metres. Prices shall include preparation of bending schedule and calculation of

weights from reinforcement drawings, submission of the same for the Engineer's approval before commencement of their placing into works.

The prices for post tensioning work shall include tendons, ducts, and vents, anchorages, their assembly/installation, stressing operations, grouting of ducts protection of anchorages and all associated works required by the specifications/drawings/contract documents and as necessary to complete the post-tensioning work. (in the case of post-tensioning with unbounded tendons, provision of ducts and vents and their grouting are not required). Prices shall include for all wastes in cutting to required lengths and for handling, hoisting and fixing in position including all necessary tying wires, spacers, chairs, and the like.

For calculation of increased costs due to change in prices of reinforcement bars, the wastage to be allowed for calculation will not be greater than 4% for bars up to size of 12mm and 6% for bars of sizes above 12mm, both of the weights measured from the schedule of reinforcement.

5.26 Specification for Roadworks

5.26.1 Site Clearance

Clearing site shall consist of clearing the ground of trees, bushes, hedges, shrubs stumps, loose boulders, piles of boulders and other objectionable material excluding soil and rock. It shall include disposal by burning, burying or carting to tip.

5.26.2 Removal of Topsoil and Roots

The whole area of the works shall be cleared completely of all roots, grass and vegetable soil irrespective of depth. The Contractor must assume an average depth of 225 mm of topsoil will require to be moved I this operation.

Selected topsoil shall be stockpiled on site and retained for use in verges and side slopes where indicated on the drawings.

The remainder shall either be carted away to tip or shall be neatly spread, leveled and finished off as directed by the engineer.

5.26.3 Protection of fences, Trees and Hedges etc

All existing paths, fences, walls, hedges, trees, shrubs, lawns and other features which the Engineer instructs shall not be removed or otherwise dealt with shall be protected from damage and upon completion of the works shall be handed over in a proper state to the satisfaction of the Engineer.

When fences, walls and other structures are damaged by the contractor they shall be made good at the Contractor's expense to the satisfaction of the Engineer.

5.26.4 Setting out

Before starting work the contractor shall set out the road centerline with temporary markers every 20 metres and at the horizontal intersection point.

Permanent pegs outside the working area should be established as follows:

1. Pegs at both sides of the road at right angles to the centerline at each 20m station, from which the centerline station point can readily be obtained at any time.
2. Reference marker pegs from which the horizontal intersection point can readily be obtained.
3. Temporary pegs shall also be established at the limit for stripping topsoil.
4. Temporary pegs should be 12 mm diameter mild steel rods at least 600 mm long with about 200 mm left projecting above ground.
5. Permanent pegs shall unless otherwise agreed by the Engineer, be 450 mm mild steel rods 12 mm diameter set in concrete at least 300 mm deep by 250 mm diameter. The steel rod should be projecting about 20 mm above the concrete. The station and distance from the centre line should be clearly marked to be the Engineer's satisfaction.
6. Before starting the works the Engineer shall check and agree the setting out and the level of the existing ground with the Contractor.
7. All permanent marks shall be carefully preserved so that the work can be checked at any time.
8. Permanent bench marks shall be established in suitable positions and agreed with the Engineer. These should be maintained so long as they are needed to check the work.

5.26.5 Measurement and Payment

1. Site clearance will be paid as a lump sum as inserted in the bill of quantities and the lump sum shall include the cost of disposal in accordance with the specification.
2. Removal of top soil will be measured per square metre.
3. Setting out- No separate payment will be made for any work in connection with the Contractor's basic and detailed setting out or any other works required to ensure that the accurate location and construction of the works.

5.26.6 Drainage of works

All cuttings, embankments and borrow pits shall be kept free of standing water and drained during the whole of the construction.

Should water accumulate on any part of the earthwork either during construction or after construction until the end of the maintenance period, giving rise to soaking or eroding

conditions in the earthworks, the Engineer may order the contractor to remove and replace at the Contractor's expense any material which has been so affected.

All drains shall be maintained throughout the Contract in proper working order.
Well in advance of commencing earthmoving operations over swampy or waterlogged areas, the Contractor shall cut drains and ditches and carry out any other works as are necessary to assist in draining the ground.

The contractor must allow in his rates for drainage the earthworks satisfactorily at all stages during the construction and arrange his methods and order of working accordingly. No work above the subgrade shall be executed until the subgrade has been inspected and approved by the Engineer.

5.26.7 Excavation

- Excavation shall be completed to the lines and level shown on the drawings.
- Excess excavation below the levels shown on the drawings shall be avoided.
- Excess excavation shall not be paid for and the Contractor shall at his own expense reinstate and make good with approved material thoroughly compacted in layers not exceeding 200mm thick to a density of not less 95% BS Heavy M.D.D.

5.26.8 Ground Water

The Contractor shall keep dry by pumping or other approved means all excavations and trenches for as long as directed by the Engineer.

Dewatering of excavations will not be paid for as an extra.

5.26.9 Excavated materials

All excavated material shall either be used for fill (if approved by the Engineer) or disposed of (spoil) if in the opinion of the Engineer, it is unsuitable for incorporation in the works.

5.26.10 Ground to be inspected before filling

Before any fill is commenced, the Engineer shall inspect the area. The Contractor shall inform the Engineer of either soft spots or underground seepage encountered. The Engineer shall order and give details of any subsoil drainage where required.

The subgrade shall be cleaned of all foreign matter and any potholes, loose material, ruts, corrugations, depressions or other defects which have appeared in the subgrade layer due to improper drainage, traffic or any other cause shall be corrected and if directed by the Engineer, the Contractor shall scarify, grade and recompact the subgrade to line and level at his own expense.

5.26.11 Materials for embankment and fill

Two types of materials shall be considered.

1. Material for construction of main body of embankments which shall have a plasticity index of not more than 30% and contain boulders not greater than 250mm maximum dimension.

2. Selected materials for the construction of the top 30cm of the embankment or for filling areas from where unsuitable material has been removed.
    a) The plasticity index shall not be more than 25%.
    b) The maximum size of boulders not greater than 100mm.
    c) CBR value after 4 days soaking at 95% B.S Heavy M.D.D shall be not less than 10%. The CBR specimen shall be prepared at B.S Heavy OMC +2%.
    d) Swelling not more than 1%.

5.26.12Filling and compaction of embankments and Fills

Materials for constructing the embankments shall be approved fill material obtained from the excavations, cuttings and approved stockpiles or borrow pits. Embankments shall be constructed in layers parallel to the final road grade. The compacted thickness of layers of fill material shall not exceed 300mm and shall not be less than 100 mm. Rockfill may be used in the bottom layers of the embankments and each layer should not exceed 600mm in thickness. The maximum particle size in a layer of fill shall not have any linear dimensions greater than 150 mm for normal fill material and 400 mm for rockfill.

The top 600 mm embankment shall consist of normal material and not rock. Where rock has been placed below this layer, the Contractor shall blind each layer of the rock with approved fine material to prevent later downwards percolation of fine particles from the upper layers and the whole layer then compacted by an approved method. More fine materials shall be added and the layer again and compacted until the voids are then completely filled.

Where directed, the contractor shall excavate benching on natural sideslopes greater than 1 in 3 steps not less than 3m wide prior to the construction of embankments. The existing slopes shall be benched by cutting steps at right angle to the slope as directed by the Engineer. The material so excavated shall be used as fill material for forming embankment, or carted to spoil as directed by the Engineer. All fills shall be compacted to a density of 95% BS Heavy Compaction at ± 1% to -2.5% of optimum moisture content for the full design width and depth. In addition, the top 300 mm of fill shall be compacted to 95% BS Heavy Compaction at ± 1% to -2% of optimum moisture content for the full design width.

In tipping and forming the embankments, the contractor shall make allowance in the height and width of these for consolidation and shrinkage. On completion of the Contract, the dimensions of the embankments shall be to the profile shown on the drawings and the necessary allowance being made for the surface finish. No sand slurry, mud, peat, organic, soft or otherwise unsuitable material, shall be placed in embankments.

5.26.13Unsuitable material in Subgrade

Where, in the opinion of the Engineer, material unsuitable for the direct support of the pavement occurs in cuttings, the Contractor shall excavate it to the depths and widths directed and replace it with selected fill material or hardcore material not exceeding 200mm in size to form an improved subgrade. The work will be paid for at the appropriate rates of “spoil” and “fill” and no additional payment will be made.

5.26.14Subgrade Compaction

The top of the subgrade in both cuttings and embankments shall be compacted to 95% B.S Heavy M.D.D unless directed otherwise by the Engineer.

The maximum compacted thickness in the top layer of the subgrade shall not exceed 200mm. The layer shall be scarified and mixed. Water shall be mixed in, or the material allowed to dry out to within +3% to +1/2 % of the optimum content before rolling.

Rolling shall include a minimum of 4 passes of a 10 ton vibrating roller, and rolling shall be continued until no further movement is visible under the roller wheels.

During this process the surface shall be graded parallel to the cambered road surface indicated on the drawings.

Tolerances

1. The following tolerances will be permitted in the levels of the upper surface of the top of subgrade layer:

Table 5.2: Tolerances in levels of upper surface of the top subgrade layer

Name	Variation permitted		
	Level (mm)	Camber (mm)	%Grade in 30m
Top of subgrade layer	+0mm -60mm	+0mm -30mm	0.1

2. in the final trimmed slope of cuttings, a tolerance of 1/8 will be permitted, i.e. if the slope of 1 in 2 is specified, the acceptable slope shall be not steeper than 1 in 1 78/8 or slacker than 1 in 2 1/8, and the rate of change of slope not be greater than 1/8 in 50m.

3. in the final trimmed slopes of embankments a tolerance of plus ¼ only will be permitted, i.e. if the specified slope is 1 in 2, the acceptable slope shall be not steeper than 1 in 2 or slacker than 1 in 2 ¼, and the rate of change of slope shall not be greater than ¼ in 30m.

4. The tolerance permitted in the overall width of the bottom of cuttings shall be 75mm in the distance between the centre line of the road and the toe of the cutting slope.

5. The width of embankments measured as the distance from the centre line of the road to the top of the embankment, shall be never less than the design width.

The contractor shall be paid for the net volume of the earthworks measured from the standard cross-sections and the original ground levels. Any additional material excavated or filled within or beyond those tolerances will be at the Contractor's expense.

5.26.15Measurement of earthworks

Prior to construction of any earthwork or excavation the levels of the existing ground shall be agreed between the Contractor and the Engineer. If the Contractor fails to take the requisite level, then the ground levels shown on drawings or determined by the Engineer shall be taken as correct.

All excavation for earthworks for road cuttings and embankments will be measured as the net volume in cubic metres of the compacted embankments as measured off the cross section drawings, called "fill", and the net volume of the spoil heaps measured from ground levels before spoiling and ground levels after spoiling, called "spoil".

If a cutting is over excavated, then the volume of overcut measured in cut when compacted to the standard cross section, shall be deducted from the volume of spoil as measured.

5.26.16Compaction standards

The terms used for compaction shall be ascribed to them the meaning given in British Standards B.S. 1377 Part I, General.

The standard of compaction used throughout the work shall be the British Standards test as described in B.S. 1377, Part 4. Wherever the text of the specification the “X% B.S. Compaction” is used, it shall mean a standard of compaction such that the dry density of the compacted material is X% of the maximum dry density ascertained from the aforementioned British Standard Compaction Test.

5.26.17Hand Packed Hardcore Sub-base

Just prior to placing of hard core, rock sand shall be evenly spread on the prepared subgrade and rolled with a 10 ton roller for at least 2 passes to give a compacted layer of 50mm thickness.

The stones shall then be positioned by hand with the greatest dimension vertical and the largest and flattest end downward. The larger stones shall have a maximum dimension slightly greater than the required thickness of the compacted layer. The smaller stones shall have a reasonably uniform grading and be of a nominal size suitable, in the opinion of the Engineer, for filling the surface voids in the larger stones as placed.

After placement of the stones in the specified manner the material shall be initially compacted with a 10 ton roller or an equivalent 1½ tonviratory roller until the layer is thoroughly keyed and the compacted layer contains no more than 10% void. Rock sands shall then be spread and broomed into the interstices and rolling shall continue until no more fines will go in to give a homogeneous compacted layer of sub-base. Sprinkling of water to enable rocksand to go in shall be to Engineer’s approval.

The irregularities that may show up during compaction shall be corrected by loosening the surface and removing or adding material as may be required, and recompacting. Samples of the compacted layer will be excavated to check on the density and void content achieved.

Hardcore shall consist of clean broken basaltic stone of size not exceeding 150mm free from an excess of flat or elongated particle, clays, loam, topsoil, or other deleterious matter. Hardcore shall comply with the following:

1. Aggregate crushing value: not greater than 40%
2. Los Angeles Abrasion Value: not greater than 65%
3. Plasticity index: On product of Los Angeles test not greater than 12.

5.26.18Crusher Run Base Course

Crusher Run Material

The crusher run shall be made from approved blue basalt rock and shall contain particles that are roughly cubical in shape and free from excess of flat or elongated particles or clay, topsoil, or other deleterious materials and shall be to the Engineer's approval.

Grading of Crusher Run

The crusher run for base and sub-base shall conform to the following grading Table 13.9 below:

Table 5.3: Grading of Crusher Run

Nominal Size of the Sieve (mm)	Percentage passing by Weight	
	0-31.5mm	0-20mm
50	100	-
31.5	92-100	100
20	78-91	90-100
10	56-76	60-80
6	42-64	45-64
4	36-55	36-54
2	25-42	25-40
1	17-30	17-29
0.5	10-21	12-21
0.08	3-8	5-8

The Los-Angeles value shall not exceed 32 for 0-31.5 mm and 30 for 0-20 mm.

The sand equivalent value shall be more than 50 for 0-31.5 mm and 60 for 0-20 mm.

The flakiness index shall not exceed 40%.

All the material shall be non-plastic.

Note: the frequency of testing shall be at least:

1. Sieve analysis: 1 per day
2. Sand equivalent: 1 per 500m³
3. Log Angeles: 1 per 2500 m³

Where the crusher run material is deficient in fine aggregate, and in the opinion of the Engineer the Contractor has made every reasonable effort to produce the required grading, the Engineer will allow admixing of crusher fines.

The percentage of added fines will be decided by the Engineer, and shall in any case not exceed 15 per cent by weight of the mixture. The plasticity index of fines shall not be greater than 6 and the liquid limit not greater than 20.

No extra payment will be made for providing and mixing in of such fines.

Mixing and spreading

Every reasonable effort shall be made to prevent segregation after mixing and during the dumping and spreading operation.

Where the addition of fine materials is necessary it shall be thoroughly mixed in with the crusher run aggregate before the introduction of any water that might be required.

Water shall be added as necessary so that compaction of the spread material is carried out within the range of -2% to 1% of the optimum moisture content.

The batching and mixing plant and method of operation shall be to the Engineer's approval.

Upon completion of mixing, the material shall, without delay, be spread by approved mechanical means.

The crusher run shall be laid and compacted in layers not exceeding 200 mm. Where a greater depth is required, the material shall be laid in two or more layers.

Compaction and Slushing

As soon as possible after spreading each layer, compaction shall be carried out. During compaction, care shall be taken to maintain the moisture content evenly at the required amount. The main compaction shall be carried out with either a power driven three-wheel roller weighing not less than 10 tons or a vibratory roller approved by the engineer. Compaction shall be continued until:
The specified density is achieved when measured by a Nuclear Moisture/ density gauge (Type ELE-CPN Nuclear gauge or MC3 Portaprobe moisture/density gauge or approved equivalent), or other approved mean.

And

The compacted pavement layer contains not more than 15% voids for road base, or 20% voids for sub-base. Voids being air voids plus voids filled with water.

Rolling shall be carried out in a longitudinal direction and shall commence from the outer edges of the road and progress inwards towards the centre except that on super elevated curves, rolling may progress from the lower to higher edge.

Any irregularities that show up during rolling shall be corrected by loosening the surface and removing or adding material as required.

After the main rolling, each layer shall be saturated with water, slushed and rolled until all excess fines have been brought to the surface and the surface shows a tightly bound mosaic of stones and no appreciable movement is visible under the wheels of a roller. Any patches of

voids shall be filled by loosening up the layer and grouting with screenings approved by the Engineer.

Drainage of Crusher Run Base

It is essential to provide free drainage paths maintained in good working order so that water passing through the crusher run layers can drain away.

Any soft spots which subsequently appear in the subgrade due to moisture accumulation shall be removed together with the overlying layers and replaced the required standard at the Contractor's expense.

Tolerances in Crusher Run Layers

The thickness of the crusher run layer shall not vary by more than 0 mm or ±10 mm.

The final surface of the crusher run layer shall not vary by more than ±6 mm from a 3 m straight edge.

5.26.19Prime Coat

Priming of surface

Before priming, any surplus fines and loose or foreign material shall be brushed off or otherwise removed to reveal a closely knit compact mosaic of stones (to be approved by the Engineer)

Priming shall be applied by a pressure distributor of a type approved by the Engineer. Hand spraying shall not be permitted except for small areas where approved by the Engineer, or to make good a defective area left by a blocked nozzle.

The primer shall be medium curing cut back bitumen M.C.30 or other approved binder.

The rate of spray will depend upon the texture and density of the surface but will usually be in the range of 1.0 to 1.3 Kg/m³. The quantity must give complete coverage of the surface with a slight trace of run off in places. Should the contractor find that when using the rate of spray directed by the Engineer, the coverage is inadequate, or there is too much run-off, he shall immediately inform the Engineer, and amend the spray rates as directed by the latter.

Before the spraying is commenced the apparatus shall be tested on a clean metal sheet. Spraying shall not commence if any nozzle is not working properly.

Spraying shall be discontinued immediately in case any nozzle becomes defective and the defective patches made good by hand spraying.

During spraying, all kerbs, road furniture, curlverts headwalls and the like shall be protected from splashing of bitumen. Any such feature which is accidentally marred by bitumen shall be cleaned off or made good at the Contractor's expense.

Curing of Prime Coat

The prime coat shall be allowed to dry out before anything is allowed to pass over the surface. Where the primer puddles, the surplus shall be blinded with sand or quarry dust until the free bitumen is absorbed. Forty-eight hours after priming, the Engineer may permit pneumatic-tyred vehicles to run over it, provided the surface is lightly sanded or dusted where necessary to prevent adhesion of the bitumen to the tyres. Such use of the surface is to be discouraged and may only be undertaken on the express written instruction of the Engineer.

Any repriming or other reinstatement that become necessary as a result of the Contractor allowing traffic to run over the primed surface, shall be carried out at the Contractor's expense.

The prime coat surface shall be approved by the Engineer before any laying of premix commences.

5.26.20 Tack Coat

A tack coat shall be applied between the bituminous base course and wearing coarse or in the case of resurfacing works between the existing road surface and the reshaping course and between the reshaping course and the wearing course. The new tack coat may also be ordered by the Engineer at the Contractor's expense if the coated surface becomes contaminated by the action of traffic and weathering. The surface of the length to be tacked shall be swept clean of all loose particles and dust with a mechanical broom immediately prior to the application of the tack coat which shall comprise either R.C. 70 or rapid setting, bituminous emulsion applied at the rate of 0.5L/m².

5.26.21 Heating of Bitumen and Safety Precaution

Bitumen shall be heated in approved boilers or storage containers equipped with adequate pumps and accurate thermometers to the temperatures within allowable limits for each penetration grade.

Table 5.4: Heating Temperature of Bitumen

MATERIAL	TEMPERATURE °C	
	MINIMUM	MAXIMUM
Penetration Grade 60/70 and Grade 70/80	160	180
M.C.O (M.C.30)	35	65
M.C.I (M.C. 70)	45	85

No bitumen shall be heated above the maximum temperature given above, and any that is accidentally over-heated shall be removed from the site and disposed of by the Contractor at his own expense.

The Contractor should take every reasonable precaution to avoid fire or health hazards while heating and handling bitumen.

5.26.22 Construction Limitation

No bituminous construction work will be permitted during adverse weather conditions or whenever so directed by the Engineer.

5.26.23 Surface Dressing

a) Materials for surface dressing

The chippings used shall be approved basalt nominally single sized, free from dust and having a flakiness index not exceeding 35% and complying with grading requirements of B.S. 882.

b) Rate of spread of chipping

The rate of chippings applied must be sufficient to cover the entire surface of the binder film after rolling. The recommended range which depends on the shape, size, specific gravity as well as the traffic density is given below.

Table 5.5: Rate of Spread of Chipping

NOMINAL SIZE OF CHIPPINGS (mm)	RATE OF APPLICATION (Kg/m²)
6	6-8
10	9-12
14	12-15
20	15-20

c) Rate of application of Binder

The amount of binder required depends on the size of chipping, the shape and absorbency of the chipping, the absorbency of the road surface. Typical rates of spread of binder lie in the range of 0.9 to 1.5 l/m². The Engineer may, from time to time, direct the Contractor to vary the rates of application, and the Contractor shall allow in his price for such variation in application.

d) Application of bitumen

The surface having been primed must be thoroughly brushed and lightly sprayed with water. Any defect in the primed surface must be rectified by patching with a mixture of fine chipping and bituminous emulsion.

Bitumen shall be sprayed mechanically by means of an approved pressure distributor having an automatic control of the rate of application such that spraying is uniform whatever the running speed. The distributor must contain a temperature gauge and it is essential that the correct temperature is maintained during application. All road furniture, kerbs culverts, etc must be protected from splashing of bitumen.

e) Application of chippings and Rolling

Chipping shall be spread immediately after application of binder by mechanical means or an approved "spreader box" mounted on a tipping lorry and adjusted as to rate of delivery and lorry speed to give the rate application specified. Immediately after application of the chipping, the surface shall be rolled so that the whole area receives at least one pass within five minutes of the bitumen being sprayed. Immediately after initial rolling, any area deficient in chipping shall be made good by hand spreading. Brooming of material to effect redistribution will not be permitted. The rolling shall recommence at te shoulders working inwards to the centre of the road. A minimum of 5 passes shall be required. Pneumatic tyred rollers are preferred for initial rolling of all surface dressing work although the Engineer may approve smooth steel wheeled rollers of 2-6 tons equipped with approved devices for moisturing the tyre surface.

As soon as the chippings are firmly anchored in the bitumen, rolling should be discontinued. At the Engineer's discretion, the application of the second coat in double seal coat work may be delayed. If this is done, the first coat must be brushed, cleaned, and patched as necessary before the second coat is applied.

After the application of chippings, the contractor shall maintain labour to sweep loose chippings back on to worn tracks on the road for a period of 2 weeks, or longer if ordered by the Engineer. Thereafter, surplus chippings ("whip-off") shall be removed and may if sanctioned by the Engineer, be re-used.

f) Single surface dressing

Where single surface dressing is specified the rate of application of binder shall be 0.9 to 1.1 l/m² and 10 mm nominal size of chipping shall be spread at a rate of 9-12 kg/m² and rolled as specified. These average rates will be adjusted on site as directed by the Engineer.

g) Double surface dressing

Bitumen shall be applied at the rate of 1.0 to 1.2 l/m² on the primed surface and 20 mm nominal size of chipping shall be spread and rolled as specified. The second application of binder shall be at the rate of 1.2 to 1.4 l/m² and shall be followed by spreading of 10mm nominal size chipping. The surface shall be rolled with 6-10 passes of pneumatic tyred roller.

5.26.24 Asphaltic Concrete

a) General

The bituminous surfacing to be used is a mixture of dried, hot aggregate and hot straight run bitumen. The mixture is designed in accordance with this Specification, which makes provision for the use of aggregate of pre-determined grading, together with adequate bitumen to meet the specified strength and stability criteria.

The bitumen binder shall be of grade 80/100 penetration unless otherwise ordered in writing by the Engineer.

b) Aggregate

The aggregate for asphaltic concrete shall consist of crushed rock.

The aggregate shall be of approved homogeneous stone free from harmful material with an aggregate crushing value of less than 25% and the loss after 5 cycles of the Sodium Sulphate Soundness test less than 12%.

Coarse aggregate for bituminous materials (wearing course and base course) shall be obtained from approved source of homogenous stone, free from harmful material, and shall consist of crushed rock of 37.5mm minimum size prior to crushing.

The aggregates shall be obtained by mixing 3 classes D/d of materials defined for each class by the maximum size (D mm) and minimum size (d mm) of particles.

Dimensions D and d will be chosen in the following series of sieves sizes: 2-6.3-10-14-20-25.

Before the work starts, the Contractor shall submit to the Engineer's approval, the grading curve of reference for each class of material.

The grading curve of reference shall satisfy the following requirements:

1. Percentage by weight of material retained by sieve D mm shall not be more than 10%.
2. All material shall pass sieve 1.25 D mm.
3. Percentage by weight of material passing by sieve d mm shall not be more than 10%.
4. All material shall be retained by sieved 0.63 d mm.
5. Percentage by weight of material passing sieve (D=d) divided by two mm shall be within the range 33-67%.

The total variations, by percentage, around the grading curve of reference for each class of material such as proposed by the Contractor at the commencement of work shall not exceed the following values for pavement course (wearing course and base course)

Table 5.6: Percentage variations around the grading curve for pavement course

Nominal size of the Sieve (mm)	Percentage by weight passing	
	Wearing Course	Base Course/Reshaping
25	-	100
20	-	95-100
16	-	91-99
12.5	100	75-91

10	94-100	51-79
5	51-63	38-57
2	32-42	23-38
0.6	16-23	10-19
0.08	7-9	5-7

Clean, cubical, moderately sharp natural sand consisting of grains of quartz or other durable rock free from a coating of any injuries material and also free from clay, loam, organic matter, may be used with the approval of the Engineer to replace all or part of the aggregate smaller than 2.35 mm B.S test sieve. Rounded sands will only be permitted with the approval of the Engineer to replace up to half the aggregate smaller than 2.36 mm.

c) Filler

The filler for asphaltic concrete shall be defined as the material passing the 75 micron B.S Sieve.

For base course asphalt the rock dust filler shall not exceed 2% by mass of the total aggregate including filler. The remainder of the filler shall be mineral filler.
For wearing course asphalt the rock dust filler shall not be varied once the design mix has been approved without the consent of the Engineer.

Mineral filler for asphaltic concrete shall be ordinary portland Cement to B.S. 12 or rock dust. At least 75% by mass shall pass the 75 micron B.S. test sieve and the bulk density in toluene shall not be less than 0.5 g/ml and not more than 0.9 g/ml as measured in accordance with B.S. 812.

d) Asphaltic concrete Gradings

The Grading of the combined aggregate and the filler shall be a smooth curve within and approximately parallel to the approximate envelope limits given in paragraph (2) above.

If in the opinion of the Engineer the available aggregate is such that adhere to one or all of the above grading envelopes means that the specified mix properties cannot be satisfactorily obtained, then the Engineer shall issue revised gradings to replace those given above.

e) Absorptive Aggregates

Where aggregates have water absorption in excess of 1% as measured in accordance with B.S 812, some absorption of bitumen will occur that will affect the voids in the mix. In this case, the voids in the mix and voids filled with bitumen are to be calculated using the specific gravity of the coated uncompacted mix determined in accordance with ASTMD 2041.

f) Mix requirement

The working mix shall comply with the following requirements for the Marshall Stability Test ASTM D 1559 based on 75 blow compaction of the specimens.

Table 5.7: Working Mix Requirement

Name	Base Course/Reshaping	Wearing Course
Marshall stability at 60ºC	800kg	1100kg
Flow Value	2mm- 4mm	2-4mm
Voids in Mixed Aggregates	14-18%	16-20%
Voids in Total Mix	3-8%	3-5%
Voids filled with Bitumen	66-77%	70-80%

g) Job Mix formulas

The contractor shall carry out trial mixes to determine then job mix at least 30 days before production of bituminous mixes is started and as soon as possible after commencement of aggregate production.

The contractor shall submit for the approval of the engineer the job mix formulas and results of the tests carried out on the trial mixes including the results of tests carried out at ranges of bitumen content from below the proposed bitumen contents of above. Specimen tests on each asphaltic content shall be made in quadruplicate.

h) Mixing plant

Asphaltic concrete shall be prepared in a central mixing plant conforming to requirements of ASTM designation D995 which shall be capable of and operated so as to produce a mixture within the Job Mix Formula.

i) Preparation of Aggregates

Aggregates shall be furnished in at least three sizes. Each type of aggregate as delivered shall be stockpiled separately. Where cold feeder bins are used, each fine aggregate shall be placed in a separate bin, or, should the number of aggregate types being used make this impossible, the fine aggregates shall be thoroughly blended in such a manner and in such proportions as approved by the Engineer prior to being placed in the feeder bin. Aggregates shall be handled and transported between the crushing and screening plant and the stockpiles and the dryer, by plant and methods which shall ensure that segregations does not occur and that moisture content variations are not large enough to affect the uniformity of the temperature of heated aggregates at entry to the mixer. Aggregates shall not be permitted to roll down the slopes of stockpiles in either placing or feeding the dryer.

Stockpile layer of aggregate with moisture contents differing sufficiently to affect the uniformity of the said temperatures shall not be worked simultaneously. The mechanical feeders shall be adjusted to provide delivery of the desired proportions to the dryer. The aggregate shall be heated and thoroughly dried before entering the hot-

bins such that the moisture content of the aggregates, determined as it enters the mixer shall be such that the temperature of the finished mixture will be within the tolerance specified. The heated and dried aggregate shall be separated into at least three sizes as approved by the Engineer. Filler shall be stored and batched separately and may not be heated.

j) Preparation of asphaltic Concretes

The aggregate without filler, prepared as specified above, shall be accurately weighed, and conveyed into the mixer in the proportionate amounts of each aggregate size required to meet the Job mix. The required amount of bitumen for each batch shall be introduced in the mixer. In batch mixing, the bitumen shall be added after the aggregates have been introduced into the mixer and mixed for 5 to 10 seconds.

The filler shall be added after the bitumen and mixing shall continue after the addition of filler for at least the length of time recommended by the manufacturer or such longer time as is necessary to ensure adequate coating of aggregate and uniform distribution of filler. The plant shall both be operated at a higher production rate than the manufacturer's rated capacity.

Bitumen shall be heated to enter the mixing chamber at a temperature such that its kinematic viscosity is in the range of 150 to 300 centistokes. At no time shall bitumen be heated in excess of 180ºC and any that is so heated shall be removed from site at the Contractor's expense. The aggregates, excluding filler which shall not be heated, shall be heated to enter the mixing chamber at a temperature varying not more than 150 ºC from that of the bitumen. The temperature of the aggregate and bitumen shall be chosen within the above limits and having regard to the prevailing air temperature and haulage distance to ensure that the temperature of the mix is between 120ºC and 200 ºC shall be provided in the bitumen heating tank and for use in the mixing chamber or at its discharge point.

Thermometers for observing air and surface temperature between 1 ºC and 66 ºC and for observing mix temperatures between 93 ºC and 180 ºC shall be provided at each laying point.

The volume of the aggregate and bitumen shall not be so great as to extend above the tips of the mixer blades when the blades are in a vertical position. All overheated and carbonized mixtures, or mixtures which foam or show indication of moisture will be rejected. When moisture is detected in the finished mixture all aggregates in the bins shall be removed and returned to stockpiles.

k) Transport of mixture

The mixed materials shall be transported from the asphalt plant to the site of work in trucks having clean, tight smooth bodies which shall be treated to prevent adhesion of the mixture.

Soapy water or lubricating oil may be used for coating of the bodies; gasoline, kerosene or other solvent shall not be used for this purpose.

The bodies of the truck shall if required by the Engineer be covered and insulated to maintain the heat loss within the requirements.

l) Laying of Mixture

Immediately before placing the mixture, the existing surface shall be cleaned of all loose and deleterious materials. The speed of the approved mechanical paver shall be regulated to eliminate pulling or tearing of the mix during placing.

The temperature of the mixes measured in the receiving hopper of the asphalt paver shall not be lower than 130 ºC. Mixes which have lower temperature shall be discarded.

The 150mm width of strip along the edge adjacent to the area on which the succeeding lane will be placed shall be left unrolled until the adjacent lane is placed. After the preceding lane has been compacted, the adjacent lane shall be placed, finished and compacted for the preceding lane, except that the rolling shall be extended to include the 150 mm width of strip not previously compacted.

The contractor shall so arrange his work that all adjacent lanes over any section of the road being surfaced are placed, compacted and finished off the same day.

At joints with existing compacted bituminous surfacing, whether it is new or old, the edge of the existing surfacing along the joint shall be neatly cut away in straight lines over a sufficient width to ensure full specified thickness of new surfacing being placed and the exposed edges in the existing work shall be painted with hot bitumen immediately in advance of placing the new work.

If for any reason, the pave should drift away from an adjacent lane during construction, the unfilled space so made shall be carefully filled with fresh hot mixture obtained from the hopper of the pave or from the truck. Stealing mixture from that already spread to fill up those areas will not be permitted.

In limited areas, where the use of mechanical spreading and finishing equipment is impractical, the mixture may be spread by hand. When hand spreading is permitted, the mixture shall be dumped on metal sheets outside the areas by means of hot shovels. The mixture shall then be spread by means of hot rakes using the back of the rake for distributing the material and reducing the amount of raking to a minimum in order to avoid segregation of the various size of aggregate in the mixture.

Any fresh mixture spread accidentally on the existing work at a joint shall be carefully removed by brooming it back on to uncompacted work, so as to avoid formation of irregularities at the joint. The finish at joints shall comply with the surface requirements and shall present the same uniformity of finish, texture and density as other sections of the work.

Any defects in the surfacing work, caused by faulty workmanship, shall be corrected and made good by the Contractor at his own expense and to the satisfaction of the Engineer. Care shall be exercised at starting and stopping of the paver to prevent the formation of lumps and depressions.

m) Compaction of mixture

Roller operators shall be fully trained and experienced men. Immediately after spreading, the mixture shall be rolled with an 8-10 tons smooth steel wheeled rolled or a pneumatic tyred roller. All rolling shall be longitudinal and shall commence at the outer edges of the road. The layer shall be compacted while the mixed materials temperature is within 130 ºC to 115 ºC. The roller shall be driven so that the driven wheels are closest to the spreader and all steering shall be carried out when on compacted material. Rolling shall continue until the surface is of uniform texture and density, free from roller wheel marks, and true to grade and cross-section. Rolling speed should be about 3km/hr. the roller wheels shall be clean and smooth and to prevent adhesion of the mix the wheels shall be kept moistened with water, but an excess of water will not be permitted.
At all places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers. Hand tampers shall weigh not less than 12 kg and shall have a tamping face of not more than 0.03 m^2.

Any mixture which does not comply with the specification or is in any way defective shall be immediately removed and replaced with fresh hot mix which shall be immediately compacted to conform with the surrounding area, all at the contractor's expenses. Skin patching on a rolled area will not be permitted.

The voids ratio in the compacted layer shall be in the range of 2% to 4% in footpath, 3%-6% for the road wearing coarse and 3%-8% for the base coarse. The density shall be more than 97% of the density determined in the Marchall Test.

The roller must never be allowed to stand on freshly laid premix.

n) Trial Area

The contractor shall arrange for a trial area of bituminous concrete to be laid in an area to the required thickness using the plant and methods to be used for the permanent surfacing to the full width normally produced by the plant and not less than 50m long. Samples shall be taken and tested in accordance with this specification from a representative part of the road base, base course, and surfacing where directed by the Engineer.

In case the trial lay fails to meet the design standards, the mix and workmanship shall be adjusted and new trial lays repeated until a satisfactory and specification complying layer is achieved all to the expense of the Contractor.

At the risk of the Contractor the trial area may be laid as part of the permanent work. In that case any layer proved by tests to be defective shall be removed by the contractor at his own cost. The Contractor shall allow for the cost of complying with the obove in his tender.

o) Joints

Transverse joints in the wearing curse shall be offset at least 500 mm from those in the base course. Longitudinal joints shall be offset at least 150mm. At transverse joints between existing compacted surfacing and newly laid surfacing, the edge of the existing surfacing along the joint shall be neatly cut away in straight lines over sufficient width to ensure that the full specified thickness of new surfacing is placed. The exposed edge in the existing work shall, if directed, be painted with hot bitumen immediately in advance of placing new work. Where the bituminous layers are laid in half widths, the longitudinal joints between them shall, if directed, be treated similarly to the transverse joints.

p) Dimensional tolerances

The finished surface of the premix wearing coarse shall be true to line, grade and cross-section and when tested with a 3m long straight edge applied parallel to the centre-line of the road and when tested with a crown template or camber board conforming to the specified cross-section applied at right-angles to the centre line of the road, the variation of the surface frome ach testing edge, between any two contacts with surface, shall at no point exceed 4 mm.

Any irregularities exceeding such specified tolerances shall be suitably corrected by the contractor at his own expense until these requirements are met. Corrective work shall be carried out in such a manner as to blend in colour, texture and finish with adjacent work.
The thickness of any layer of premix shall at no point be less than the specified thickness.

Extra payment shall not be made for layers thicker than that specified.

q) Working mix Tolerance

When the Job Standard Mix is approved by the Engineer, The Contractor shall maintain the composition of the working mix within the following tolerances from the Job Standard Mix.

Bituminous binder:
Design mix +0.1 to -0.2% by mass of total mix

Aggregate retained on 5 mm B.S. Sieve:
Design mix ±4% by mass of total mix

Aggregate passing 5 mm B.S. Sieve but retained on 75 micron B.S. Sieve
Design mix ±3% by mass of total mix

Aggregate passing 75 micron B.S. sieve
Design mix ±1.5% by mass of total mix

The bituminous concrete shall be checked periodically and when ordered by the Engineer and shall comply with the above specified requirements.

r) Defects

Any defects in the asphalt work caused by the faulty workmanship shall be corrected and made good at the contractor's expense. Care shall be taken where starting and stopping the paver to prevent the formation of humps and depressions. Skin patching of an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective, shall be removed and replaced with fresh material and compacted as specified.

s) Preparation of Existing Bituminous surface prior to resurfacing works

Before any resurfacing operation, the existing bituminous surfaces shall be repaired where required by the Engineer.

Potholes and trenches backfilled with unsuitable or unstable material or poorly compacted shall be repaired as follows:

The edges of the hollows shall be neatly cut to a rectangular shape with appropriate tools.

Unsuitable materials shall be excavated to a minimum depth of 20 cm.

The excavation shall be filled in two layers with crusher run 0/20. The first layer shall be compacted as much as possible and the second compacted to at least 97% of B.S. Heavy compaction with a vibrating roller.

Wherever required the crusher run shall be treated with lime. The process of treatment and the rate of application of lime (between 3 or 5%) shall be submitted for the approval of the Engineer. After compaction the surface of repaired area shall not present bump or hollow of more than one centimeter.

5.27 Water in trenches

Trenches shall be kept free from water until in the opinion of the Engineer, any concrete or other works therein are sufficiently set and the Contractor shall construct any sumps or temporary drains that the Engineer may consider necessary.

The Contractor shall make good at his own costs, any damage caused by prolonged and/or excessive pumping and shall take all necessary precautions for the safety of adjoining structures and buildings by shoring or otherwise during the time the trenches are open.

5.28 Concrete protection to pipes

Concrete protection to pipes where required shall consist of plain concrete bed and concrete surround and shall be of grade 25/20 along such lengths as are shown on the Drawings or ordered by the Engineer in writing.

In carrying out this work, the Contractor shall take care to compact the concrete under and around the pipes to ensure even bedding and strength of the concrete.

The concrete must not be directly thrown on the pipes. The upper surface of the concrete shall be struck off with a wooded float and neatly finished off.

No concrete surround or haunching shall be placed until the pipework concerned has been inspected and approved by the Engineer.

The concrete protection shall be placed to the full width of the trench and never less than 150mm wider on each external side of the barrel of the pipe.

When support for excavation is provided, building paper shall be placed against that support before concreting to facilitate withdrawal of the support.

In the case of spigot and socket pipes with flexible joints the concrete protection at each joint shall be interrupted in a vertical plane at the edge of the socket by a strip of fibreboard or other material approved by the Engineer and of the following thickness:

Up to 300mm nominal bore	13mm
Over 300 and up to 600mm nominal bore	25mm
Over 600 and up to 1200 mm nominal bore	38mm

5.29 Backfilling over pipes

Where no concrete haunch or surround is called for, selected fill material, consisting, of the best available from the excavation 25mm down, shall be mixed, watered if necessary and thoroughly compacted along the barrel of the pipe. A minimum density of 90%BS Heavy Compaction shall be achieved. Similar selected material shall then be laid in layers, not exceeding 150mm loose thickness, mixed, watered if necessary and compacted, and brought up uniformly across the width of the trench to a height of not less than 300mm over the crown.

The remainder of the trench shall then be backfilled with the best selected material available, placed in layers not exceeding 150mm loose thickness, mixed, watered if necessary and compacted.

All backfilling material shall be compacted to a density of 90% BS Heavy Compaction.

Timbering and sheeting shall be eased up 150mm at a time in step with the backfill layer and compaction of the backfill to 90% BS Heavy Compaction shall be obtained under such timber and sheeting.

Over a pipe, which is not laid in a trench, bedding material shall be used in the filling operation within a distance of at least one-half of the pipe diameter of the barrel to completely surround the pipe.

In all cases there shall be cover of at least 600mm compacted thickness over the crown before any construction equipment is allowed to drive over it.

Where directed by the Engineer that the acidity of the soil used for backfilling shall be neutralized, the Contractor shall add 5% of lime, by weight, to the fill material throughout the width and depth directed by the Engineer. The lime shall be evenly spread over the surface of each layer of fill material before it is compacted and shall be mixed in the raking.

5.30 Backfilling to Structures

All material used for backfill shall be of a quality acceptable to the Engineer and shall be free from large lumps, wood or other organic or extraneous matter. All spaces excavated and not occupied by culverts, or other permanent works shall be backfilled with approved material up to the surface of the surrounding ground, with sufficient allowance for settlement.

All backfill material shall be placed in horizontal, uniform layers not exceeding 150mm in thickness, before compaction, and shall be brought up uniformly on all sides of the structure. Each layer of backfill shall be compacted to a density of not less than 90% BS Heavy Compaction. For filling to structures above existing ground level, the contractor shall so arrange his Programme for the construction of structures and earthworks that the filling behind and around any structure is carried out concurrently with, and as part of, the earthworks operation.

5.31 Miscellaneous Specifications

5.31.1 V GROOVE

Walls built against cast concrete columns and beams shall have 6mm deep v.Groove in the rendering internally and externally. Joint on floor screed shall fall immediately above the construction joint in the concrete floor and shall have a 20mm deep x 6mm wide saw cut for making panel not exceeding 40sqm.

5.31.2 Preparation of surface to receive screeding

The surface of the concrete shall be hacked to form a good key, well washed and brushed perfectly clean with a brush to remove all impurities, dust etc., damped and grouted with a mixture of cement and water in the form of slurry, using 2.75Kgs of cement per sqm. of surface area, before screeds are laid.

5.31.3 Sample Panel

The Contractor shall prepare samples of plastering, tyrolean finish, bush-hammered finish as directed until the quality texture and finish required is obtained and approved by the Architect, after which all plastering, tyrolean and bush-hammered finish executed in the work shall conform to the respective approved samples.

5.31.4 Arises

Vertical and horizontal arises shall be formed to beams, columns, openings and the like and shall be rounded. Particular care shall be taken to ensure that the rendering is strong at the corners.

5.31.5 Cracks, Blisters, etc

The contractor shall make good all cracks, blisters and other defects and leave the whole of the plaster, tyrolean, bush hammered finish perfect at completion. When making good defects, the plaster shall be cut out a rectangular shape with edges undercut to form dovetailed key and all finish flush with face of surrounding plaster, all at the Contractor's own expense.

5.31.6 Kerbs

Kerbs shall be either precast or cast-in-situ to a fair face finish as shown on the drawings. They shall be to the dimensions shown on the drawing. Concrete Grade 30/20 shall be used.

The units shall be bedded to the lines and details shown on drawings. The bottom of excavation shall be cleaned, trimmed, and compacted prior to placing of concrete.

Joints between precast unit shall not be thicker than 10 mm and shall be filled with 1:1:6 (cement: lime: sand) mortar. Tapering, radius or other kerbs which are cast-in-situ shall have a visible surface matching precast units and shall be cast in lengths not exceeding 4m.

5.31.7 Cover slabs

Cover slabs shall be built in precast concrete to the type and dimensions given on the drawings or as directed on site by the Engineer. They shall be executed in Grade 30/20 concrete.

They shall be fixed in place to the lines and levels directed by the Engineer on a smoothly prepared level surface so that no rocking occurs. The top surface shall be given an anti-skid texture by bush hammering or any other method approve by the Engineer.

5.31.8 Heavy Duty Racks

The Store shall accommodate all spare parts, PV modules and Inverters and the Contractor shall provide **three** heavy duty storage racks. The specifications for the Racks shall be as follows;

- Unit dimensions (LXDXW): at least 1.5X0.75X3m
- Material: Stainless Steel
- Layers: 4 Layers
- Weight Capacity: at least 200kg per layer
- Feature: Corrosion protection
- Colour: Black or Grey Coating

6.0 Project Requirements

6.1 General Requirements

The Project comprises of the design engineering, procurement, construction, testing and commissioning, start-up for a Solar PV Farm at Grenade, Rodrigues Island with an AC output of 1MWac measured at the Point of Common Coupling (PCC).

The PCC shall be at the new 22kV switching substation through an expandable 22kV indoor metalclad switchgear, at Grenade. The two feeders that shall be used for the evacuation of generated power shall be the 22kV Cotton Bay and Port Mathurin Feeders respectively (Refer to guide drawing R-GRE-EL02). The Contractor shall factor in its design the maximum hosting capacity of the two above mentioned feeders. The maximum hosting capacity of Port Mathurin is 1MWac and that of Cotton Bay is 400kWac.

In addition, the Contractor shall also be responsible for surveys and civil engineering works.

For this Project, the Contractor is required to provide mono-crystalline PV cell technology with module capacity rating between **300 - 385W.**

6.2 Scope Of Supply

The scope of supply for the erection of the 1 MWac Solar PV Farm, measured at the PCC, shall include the following principal elements. The Contractor shall be responsible for identifying and providing any and all other additional equipment, components, and services necessary to install a fully functional PV farm.

1. Design, manufacture, procure, ship, transport to site, assemble, test, start-up, commissioning, warrant and make ready for service a fully functional turnkey Solar PV Farm and associated balance of plant equipment.
2. All required equipment / materials labour and tools necessary to install, test, and commissioning of the Solar PV farm and associated balance of plant.
3. Perform Geotechnical Survey, including identification of land contamination, earth resistivity, and earth resistance among others.
4. Carry out necessary excavation works to set up the support structures for the PV panels, cable trenches, manholes, earthing and lightning protection systems among others.
5. Dimension, supply, laying, test and commissioning of AC & DC cables. The cables shall be sized taking into consideration voltage drop, power loss and current carrying capacity among others.

6. Design, supply, install, test and commissioning of two concrete Compact Solar Stations, in accordance with R-GRE-EL03, and carry out the associated civil works.
7. Construction of bases for the transformers in the solar compact stations complete with oil drainage system and sump pits.
8. Design, supply, install, test and commission a 22 kV indoor Medium Voltage Interconnection Switching Substation complete with all auxiliary systems.
9. Supply, install, test and commission a fully functional communication system for local operation at Grenade and remote operation at Port Mathurin based on a fibre optic system. The fibre optic will be laid by the Employer at a later stage.
10. Design, supply, install, test and commissioning a web based communication system for remote operation from Port – Mathurin and elsewhere.
11. Construction of a concrete building comprising of a control room, a store and a 22 kV switchgear room.
12. Construction of Retention Wall and Water Drainage Systems
13. Contractor to lay supervisory cables from switchgear up to the terminals of meters within a metering panel to be located in an electrical annex. The metering panel, Drawing 6210-13, will be supplied by the CEB. The final connection and commissioning of the meter will be under the responsibility of the Employer.
14. Perform landscaping
15. Provision of appropriate drainage system including retention walls on the PV Farm.
16. Provision of necessary rain water pipes, catch pits, soak away, concrete kerbs and manholes.
17. Design of a fire alarm system of addressable type, covering the solar compact substation, new and existing building.
18. Install, test and commission protective devices for lightning and surge among others.
19. Provide classroom and on-site training classes to operators, engineers, technicians and maintenance personnel.
20. Supply any special equipment and tools required for the operation and maintenance of the project.
21. Supply, install test and commission a 22kV interconnector linking the existing wind farm 22kV panel to the new 22kV switchboard.
22. Supply mandatory spare parts and tools as provided in the list in Section 3.40.3
23. Provide warranties of at least 10 years on PV panels, 10 years on inverters, 2 years for 22 kV switchgears and transformers. All the warranties shall start as from the date of taking over of the plant. In the event that any component of the Project is damaged before the taking over and that the Contractor opts for reparation instead

of replacement, the Employer reserves the right to request for an extended warranty for the said component.

24. Submit Employer for approval all designs drawings, O&M manuals, and miscellaneous documentation required to provide a complete installation.
25. Provide all as-built drawings for the project.
26. Perform factory acceptance testing for the panels, control and protection panels, inverters and transformers.
27. Provision of lighting in electrical switchgear rooms, control rooms, store, electrical annex and Solar Compact Stations.
28. Provision of emergency lighting, in particular, to enable the performance of emergency operational procedures and for illumination of escape routes.
29. Provision of general services socket outlets within the buildings and compact solar substations.
30. Air Conditioning System for the control room and switchgear room.
31. The Contractor shall design the electrical installation, including the consumption of the Solar PV Farm, to ensure that the internal consumption of the PV farm shall at all-time be greater than 0.95 pf.
32. Testing and commissioning of the Solar PV farm
33. Work in collaboration with the CEB for the commissioning of the 22kV medium switchgear, interconnection 22kV line and communication system.
34. Provide the Dynamic Model of the PV Farm in DIgSILENT Powerfactory format.
35. Perform all design calculations. It is to be noted that all design calculation shall be approved by the CEB and CEB prior to implementation.
36. External lighting
37. Supply, install, test and commission a PLC based Control System for PV Farm.
38. Supply, install, test and commission two work stations in the Control Room at Grenade Wind Farm.
39. Supply, install, test and commission one work station in the Control Room at Port Mathurin.
40. Supply a mobile workstation complete with all application software.
41. All of the required software for PV Farm operation, testing and commissioning shall be provided by the Contractor with perpetual licenses that shall be registered in the name of the Employer
42. Any other requirements as mentioned in other sections of this Tender.

6.3 Design, Fabrication, And Construction Requirements of the Solar PV Farm

The performance of a Solar PV Farm shall be optimised by a combination of several enabling factors: premium modules and inverters, a good system design with high quality and correctly-installed components and a good maintenance and monitoring regime leading to low operational faults.

The Contractor shall use the following mitigating measures in order to optimize the plant performance:

Table 6.1: Mitigating Measures for System Design Optimization

Shading	Choose a location without shading obstacles. Ensure that the plant has sufficient space to reduce shading between modules.
Incident angle	Use anti-reflection coatings, textured glass
Module temperature	Choose modules with an improved temperature coefficient for power at high ambient temperature locations.
Soiling	Choose modules less sensitive to shading/dust.
Module quality	Choose modules with a positive tolerance as specified in section 6.4 below. Choose modules with a low degradation rate and a linear power guarantee as specified in section 6.4 below.
Module mismatch	Sort modules with similar characteristics into series strings where possible. Avoid partial shading of a string. Avoid variations in module tilt angle and orientation within the same string.
DC wiring resistance	Use appropriately dimensioned cable. Reduce the length of DC cabling.
Inverter Performance	Choose correctly sized, highly efficient inverters.
AC losses	Use correctly dimensioned cable. Reduce the length of AC cabling. Use high-efficiency transformers.
Plant downtime	Use a robust monitoring system that can identify faults quickly.
MPP tracking	Choose high-efficiency inverters with maximum power point tracking technology on multiple inputs. Avoid module mismatch.

6.4 Solar Photovoltaic Modules

The solar PV farm capacity shall be dimensioned for a power output of **1MWac** measured at the point of common coupling at Grenade and shall comprise of solar mono crystalline modules each rated between **300-385 Wp.**

The power tolerance of the modules shall be between 0 to 3%. Negative power tolerances on the module shall not be accepted. Module with capacity less than 300 Wp shall not be accepted under this bidding exercise.

Experimental modules or those under research are not allowed. Concentrating Solar PV (CPV) systems are also not being considered for this tender. Modules should have a product warranty of at least 10 years and a linear power output warranty of at least 25 years.

The module type must be qualified as per IEC 61215 latest edition. Solar PV module conversion efficiency shall be equal to or greater than 17% under Standard Test Conditions (STC) and AM 1.5 radiations.
Modules must also qualify to IEC standards as listed hereunder.

Table 6.2: IEC Standards for Solar Photovoltaic Modules

PV Modules	
IEC 62804 – 1	Photovoltaic(PV) modules – Test methods for the detection of potential-induced degradation- Part 1: Crystalline Silicon
EN 50380	Marking and Documentation Requirements for Photovoltaic Modules
IEC 61215-1	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval – Part 1: Tests Requirements.
IEC 61215-2	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval – Part 2: Test Procedures.
IEC 61701	Salt mist corrosion testing of photovoltaic (PV) modules.
IEC 61730 - 1	Photovoltaic (PV) module safety qualification – Part 1: Requirements for Construction.
IEC 61730 - 2	Photovoltaic (PV) module safety qualification – Part 2: Requirements for Testing.
IEC 61853-1	Photovoltaic (PV) module performance testing and energy testing – Part 1: Irradiance and temperature performance measurements and power rating
IEC 62979	Photovoltaic modules-Bypass diode-Thermal away test

The PV modules shall perform satisfactorily in humidity up to 100% with temperature between 0^{o}C to 55^{o}C. Since the modules shall be used in a high voltage circuit, the high voltage insulation test shall be carried out on each module and a test certificate to that effect provided.

The predicted electrical degradation at the end of the period of 12 years shall be less than eleven (11) per cent of the full rated original output.

Manufacturers / suppliers should confirm whether they are supplying PV module using a radio frequency identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions.

1. Name of the manufacturer of PV Module
2. Name of the Manufacturer of Solar cells
3. Month and year of the manufacture (separately for solar cells and module)
4. Country of origin (separately for solar cells and module)
5. I-V curve for the module
6. Peak Wattage, Im, Vm and Fill Factor (FF) for the module
7. Unique Serial No and Model No of the module
8. Date and year of obtaining IEC PV module qualification certificate
9. Name of the test lab issuing IEC certificate
10. Other relevant information on traceability of solar cells and module as per ISO 9000 series.

All information pertaining to solar PV modules shall be provided in Sheet 1 of Section VII – Schedule of Guaranteed Particulars.

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

The front surface module shall consist of impact resistant, and high-transmission toughened glass. The modules shall be capable of resisting damage when subjected to hailstorms as per IEC 61215. The module supplier shall have to furnish a certificate to ensure that the front glass surface is capable of withstanding such impact.

The module frame, if any, shall be made of a corrosion-resistant material which shall be electrolytically compatible with the structural material used for mounting the modules.

The module junction box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP65 (or higher) rated. The module junction boxes shall in compliance with IEC 62790 and be of class II insulation, of material able to withstand abnormal heat and fire up to 960^{o}C, in compliance with IEC 60695-2-11 and rated insulation 1000Vac; 1500 V DC. Moreover, since module side of the DC PV system remains alive during the day, a clear visible warning sign should be provided to inform anyone working on the junction box.

The Contractor shall also be required to submit the terms for product and power warranties.

6.5 Electrical Engineering

The Contractor shall provide all electrical engineering design services. Electrical engineering design shall be based upon a twenty five (25) years, Service life, meeting applicable codes and standards and the requirements of the interconnecting utility.

The engineering and design shall include the appropriate sizing and cabling (above and below ground) that will connect all applicable equipment to the PCC. The project electrical system shall be designed for electrical system losses no more than three (3) percent on the DC wiring system and the AC wiring system totaled.

All protection equipment used throughout the system shall be sized and specified to reduce damage to all components and to the interconnection point in the event of electrical failure.

All electrical systems and equipment shall be shall be easily accessible for troubleshooting and maintenance.

The electrical design shall include the design of equipment grounding and lightning and surge protection for the entire PV Plant site. The Contractor shall ensure that the new earth system shall provide safe touch and step voltages designed in accordance with the latest edition of IEEE 80. The new earthing system shall be connected, at least through two different connection, to the existing eathing system of the Grenade.

The Contractor shall design, supply, install and commission a lightning protection system, materials and components fully in compliance with IEC 62305.

The Contractor shall design and specify all communications hardware and software required for system protection and remote monitoring and control. All monitoring and communication supplemental equipment and cabling shall be designed and specified, subject to Employer's approval.

The Contractor shall design a 22kV network complete with two 22kV step up transformers and associated switchgears. The transformers shall be rated by the contractor.

The Contractor shall design and specify any necessary power, communications, and internet facilities required for PV Plant operation and control, remote monitoring, and the Facility security system.

The Contractor shall provide a comprehensive statement on the overall power factor control strategy for the entire solar.

The power delivered to the grid must at all times meet the interconnection requirements for power factor. A capability curve is required to illustrate the power factor control strategy.

The Contractor shall provide provisions to isolate equipment to facilitate panel/inverter maintenance and minimize impact to Facility production.

6.6 Combiner Boxes

The Combiner Boxes can be used at the point where the individual strings forming part of a PV array are marshalled and connected in parallel before leaving for the inverter through the main DC cable.

The Combiner Boxes shall be made of material able to withstand abnormal heat and fire up to 960ºC, in compliance with IEC 60695-2-11 and rated insulation 1000Vac; 1500 V DC. All wires/cables must be terminated through cable lugs.

The combiner boxes shall be such that input & output termination can be made through suitable cable glands. The Combiner Boxes shall contain copper bus bars/terminal blocks housed in with suitable termination threads conforming to IP65 standard and IEC 62208. They shall also have provisions for earthing. The combiner boxes shall be placed at about 1.5 meters height or at a height for ease of accessibility subject to the approval of the Engineer.

Each Combiner Box shall have high quality suitable capacity Surge Protective Devices (SPDs), suitable Reverse Blocking Diodes (if applicable), and protected by a set of fuses. Fuses shall have blown fuse indication. The SPD shall be in accordance to IEC 61643-11.

For protection, maintenance work and inspections, each individual string shall have a string fuse/miniature circuit breaker and a disconnector (load break switch) on both the positive and negative string terminals. Care must be taken to avoid nuisance tripping.

A main double pole DC Circuit breaker capable of breaking the full load shall be installed between the PV array fields and the inverters. Since the module side of the DC PV system remains alive during the day, a clear visible warning sign that warns against disconnection under load, should be provided to inform anyone working on the combiner box.

Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification.

6.7 DC Distribution Cabinets

The DC cabinets shall be rated at 1500 V DC and shall enclose the string interconnection systems along with the associated overcurrent protection devices, disconnectors, surge protective devices and monitoring equipment. The DC distribution cabinet shall be suitable for tropical environments and shall have a degree of protection of at least IP41 for indoor and IP 66 for outdoor. The DC Cabinet shall be made of metallic sheet of not less than 1.50mm.

The DC distribution cabinet shall have doors with hinged opening mechanism and horizontal opening direction. Also, the DC distribution cabinet shall have a door opening greater than

90° for ease of access. The DC distribution cabinet shall also be equipped with door locks. Furthermore, the DC distribution cabinet shall be composed of a base plate supporting the functional mounting and paneling elements, uprights, wiring ducts and DIN rails. Copper busbars and copper cables of appropriate cross section shall be provided for earthing and bonding. The low voltage DC distribution cabinet shall have a nameplate installed and mounted to the front cover and indicate, at a minimum: number of input circuits, ampere rating of input circuits, voltage rating, short-circuit current rating, and integrated disconnect ampere rating if provided. All live parts shall be shielded to prevent access where applicable.

6.7.1 Fuses

The fuses and fuse holders shall be in compliance with IEC 60947-3. The contractor shall define the number of PV string inputs depending on the scale and topology of the PV installation. Each string input shall be individually and independently protected, controlled and monitored. Each string input shall be protected by a properly sized fuse with the gPV time current characteristics. The rated current and breaking capacity of the fuse shall be defined by the Contractor in line with the design of the system. Each fuse shall be housed in a properly rated PV fuse holder with fuse status indication which shall be made available to the local SCADA system. The input current per string shall also be measured and made available to the local SCADA system. Depending on the incoming cable cross sections, the string input connection can be directly on fuse holder terminals through cable glands or on terminal blocks through cable glands and terminal lugs.

6.7.2 DC Switch Disconnectors

The DC switch disconnectors shall comply with IEC 60947 and shall be rated at 1500 Vdc. The DC switch disconnectors shall be selected with number of poles and current ratings to suit the circuit and application as appropriate. The DC switch disconnectors shall be easily accessible for rapid isolation. Padlocking facilities shall also be provided to enable the device to be locked in the "off" position. The terminals of the DC switch disconnectors shall be shrouded against accidental contacts. The voltage on the incoming terminals of the DC switch disconnectors shall be measured and be made available to the SCADA system. The contacts of the DC switch disconnectors shall be visible. Alternatively positively linked externally visible indication for the "on", "off" may be provided subject to approval of the Employer. In addition, the “on” and “off” position of the switch disconnectors shall be made available to the local SCADA system.

6.7.3 Surge Protective Devices

The surge protective devices shall be suitable for the PV system in accordance with IEC 60364. The type, the discharge current and the impulse current of the surge protective devices for the DC system shall be defined by the Contractor and shall be submitted to the Employer for approval. The surge protective device shall feature a local visual status indication and shall incorporate remote contact signaling to indicate normal operating state. In case of surge protective device having the technology combining disconnection and short-circuiting device

for safe electrical isolation in event of arcs, the status of the disconnection and short-circuiting device should also be made available to the SCADA system.

6.7.4 Earthing

The DC system shall be negatively grounded. All non-current carrying metalwork shall be effectively and securely bonded. In case of armored cables, the earth tape shall be bonded to the earth ring on the cable gland. All incoming and outgoing earth continuity conductors shall be effectively and securely bonded together and to earth.

6.8 Inverter Modules

The inverter modules shall convert the DC power generated by the PV strings into AC power and adjust the voltage and frequency levels to suit the local grid conditions. The inverter DC input shall be designed for at most and the inverter AC output power shall be rated between 100 – 250kWac. Inverters with AC output power rating outside the specified range of 100 – 250kWac will not be accepted.

The inverter shall be sized to provide a power output of between 100 – 250kWac at PCC without being in overloading condition and taking into consideration losses.

The Contractor shall have to choose the optimum location for inverter for each set PV arrays in order to minimize electrical losses in cables.

The technical specifications for the inverter include:

1. Control Type :Voltage source, microprocessor assisted, output regulation
2. Frequency : 50 Hz
3. DC link voltage range : 0 to 1500 V
4. Total Harmonic Distortion (THD): less than 4% at maximum power output
5. Operating temperature range : 5 to 60 deg. C
6. Inverter efficiency : above 97.5 % at full load
7. Power Control : Maximum Power Point Tracking (MPPT)
8. Overloading capacity : at least 120%
9. Other important Features/Protections required in the inverter shall include:

    a. Automatic morning wake-up and nightly shutdown
    b. Mains (Grid) over-under voltage and frequency protection
    c. Overload Protection,
    d. Over- Under Frequency
    e. Over- Under Voltage
    f. Loss of Main Protection
    g. Insulation Monitoring
    h. DC reverse polarity

i. Fool proof protection against islanding.
j. Included authentic tracking of the solar array's maximum power operation voltage (MPPT).
k. Array ground fault detection.
l. LCD and piezoelectric keypad operator interface Menu driven
m. Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.
n. Surge Protective Devices on AC and DC terminals for over voltage protection from lightning-induced surges.
o. Curtailment.

All parameters should be accessible and configurable through a Standard Industrial Port or Ethernet TCP/IP communication link and displayed on the local SCADA in the Control Room.

The 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.

The proposed inverters shall comply with the following set of standards:

Table 6.3: IEC Standards for PV Inverters

PV INVERTERS	
IEC 62894	Data Sheet and Nameplate for Photovoltaic Inverters
IEC 62109-1	Safety of power converters for use in photovoltaic power systems-Part 1:General Requirements
IEC 62109-2	Safety of power converters for use in photovoltaic power systems-Part 2: Particular Requirements for inverters
IEC 62109-3	Safety of power converters for use in photovoltaic power systems-Part 3: Particular Requirements for Electronic Devices in Combination with Photovoltaic Elements
IEC TS 62910	Test Procedure of Low Voltage Ride-Through (LVRT) Measurement for Utility interconnected PV Inverter
IEC 62920	EMC Requirements and Test methods for Grid Connected Power Converters applying to Photovoltaic Power Generating units
IEC 61683	Photovoltaic Systems – Power conditioners – Procedure for measuring efficiency
IEC 62116	Test Procedure for islanding prevention measures for Utility connected photovoltaic inverters (utility-interconnected photovoltaic inverters)
IEC 60529	Degree of protection provided by enclosures
IEC 62852	Connectors for DC-Application in Photovoltaic systems- Safety Requirements and Tests

IEC 61000-3-2	Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
IEC 61000-3-3	Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
IEC 61000-3-7	Assessment of emission limits for the connection of the connection of fluctuating installations to MV, HV and EHV power systems.
EN 61000-6-1	Electromagnetic Compatibility (EMC). Generic Standards. Immunity for Residential, Commercial and light industrial environments.
EN 61000-6-3	Electromagnetic Compatibility (EMC). Generic Standards. Emission for Residential, Commercial and light industrial environments.
IEC 61000-3-11	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection
IEEE519	IEEE Recommended practice and requirements for harmonic control of electric power systems

The inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of inverter component failure or from parameters beyond the inverter's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the inverter front panel to cause the inverter to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the inverter, including commutation failure, shall be cleared by the inverter protective devices and not by the existing site utility grid service circuit breaker.

Maximum power point tracker (MPPT) shall be integrated in the 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 provided by the Manufacturer.

The power circuits of the inverter shall be separated from the control circuits. The internal copper wiring of the inverter shall have flame resistant insulation. All conductors shall be made of standard copper.

The inverter shall go to shut down/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay:

1. **Insufficient Solar Power Input**
   When the power available from the PV array is insufficient to supply the losses of the inverter, the inverter shall go to a standby/shutdown mode.

2. **Situation of Over or Under Voltage on CEB Grid**
   The inverter shall restart after an over or under voltage shutdown when the utility grid voltage has returned within its limits after a minimum time delay of three (3) minutes.

3. **Situation of Over or Under Frequency on CEB Grid**
   The inverter shall restart after an over or under frequency shutdown when the utility grid frequency has restored within limits after a minimum time delay of three (3) minutes.

4. **Power factor**
   The solar farm shall be designed with the capability to supply rated power (MW) for power factors ranging between 0.95 lagging and 0.95 leading, available from 20% of rated power measured at POD. When operating below 20% of the rated output, the power factor may be less than 0.95 lagging.

6.8.1 Disconnection, Islanding and Automatic Reconnection after the Grid Failure Is Restored

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 inverter. This may be achieved through rate of change of current, frequency, phase angle, unbalanced voltage or reactive load variants.

Operation outside the limits of power quality as described in Chapter 12 (Guaranteed Operating Characteristics of PV Farm) hereunder should cause the inverter to disconnect from the grid. In case of the above, tripping time should be less than 0.5 seconds, unless otherwise requested by the Employer. The values shall be configurable from the SCADA System.

Inverters shall have the ability to reconnect automatically to the grid following restoration of grid supply, subsequent to grid failure condition within a minimum time delay of three (3) minutes.

6.8.2 Other Features

The inverters shall withstand a high voltage test of 2000 Vrms, between either the input or the output terminals and the cabinet (chassis).

Full protection against accidental open circuit and reverse polarity at the input shall be provided.

The inverters shall not produce Electromagnetic Interference (EMI) in accordance with EN 61000-6-1 and EN 61000-6-3, which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the inverter is housed.

The inverters 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 inverter enclosure. Operational status of the inverter, alarms, trouble indicators and AC and the DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front cover of the inverter enclosure and SCADA. The parameters of the inverter shall be configurable via the communication bus on the local SCADA system or a dedicated workstation in the Control Room.

The Contractor shall submit the assumptions, factors taken into consideration and calculations for the inverter and array sizing for approval by the Employer.

The Contractor shall provide a warranty of at least 10 years on inverters used in this project.

The number of inverters is to be defined by the Contractor based on the chosen rating of a solar station and the topology of the PV installation. The Contractor shall choose the optimum location for the inverters for each set of PV arrays taking into consideration the topology of the site, shading impact on PV modules, cable routes, electrical losses and ease of access for installation, operation and maintenance.

6.9 AC Distribution Board

The low voltage AC switchboard shall be rated at the nominal output voltage of the inverter and shall meet the requirements of IEC 61439. The low voltage AC switchboard shall have an insulation voltage of 1000 Vac. The low voltage AC switchboard shall not be of less than 2.0 mm metallic sheet, shall be of at least IP41 for indoor. It shall have a segregation of at least Form 2b. The low voltage AC switchboard shall be free standing with at least front access and bottom entry.

The arrangement of incoming and outgoing ways shall be made in a logical consistent manner taking into consideration speed and safety during installation, operation and maintenance. The fault rating of the main switchboard shall be defined by the Contractor for 1 second fully type tested and shall be fitted with air circuit breaker, molded case circuit breaker, miniature circuit breaker as required by the design of the system.

Cable glands and conduit entries shall be provided as required by the design of the system. Sufficient space shall be provided in the low voltage AC switchboard to cater for the cables to bend and spread from the cable gland plate or bar to the terminals in a logical consistent manner without crossing of cores of a cable or of adjacent cables. Moreover, adequate space shall be provided to facilitate the removal of any cable termination without the need to remove any other termination.

All conductors and bus-bars, with the exception of the earthing bars or tape, shall be clearly marked with the appropriate phase and neutral colors in accordance with IEC 60446. Operating handles, locking devices etc. shall be located within the limits of 450mm and 1900mm above floor level. The low voltage ac switchboard shall also incorporate On/Off/Trip status indicators on the front panel for all circuits.

Copper busbars and copper cables of appropriate cross section shall be provided for earthing and bonding.

6.9.1 Busbar and Busbar Connections

Busbars and busbar connections shall be of high conductivity copper and shall be extensible at both ends. Busbars shall be continuous and of constant cross section throughout their lengths with connections as short and straight as possible. Access to busbars and the busbar connections shall be gained only by the removal of covers secured by bolts and screws. Such covers shall be clearly marked "BUSBARS" along with the short circuit current rating and the fault level at the rated voltage. All neutral bus-bars shall be of the same cross-sectional areas as the associated phase bus-bars. All joints and connections to the bus-bars shall be tin coated The bus-bars and bus-bar supports shall be arranged to withstand, without damage, the effects of any fault current up to and including the maximum rated breaking capacity to the switchboard.

6.9.2 Air Circuit Breakers

Air circuit-breakers shall be constructed and tested in accordance with IEC 60947. The air circuit-breakers shall have a rated service voltage of 690 Vac and a rated insulation voltage of 1000 V. The rated uninterrupted current and the rated short-time withstand current (1 sec) of the air circuit breaker shall be defined by the Contractor based on the design of the system**.** The air circuit breakers shall be of withdrawable type. The position (connected, test, isolated) of the moving part shall be clearly indicated. It shall not be possible to rack-out the air circuit breakers unless the contacts are open. The withdrawable version shall be padlockable in "test position" and in "isolated position".
The following accessories shall be available for the air circuit breaker:

- Shunt opening/closing release
- Second shunt opening for redundancy
- Geared motor for the automatic charging of the closing springs, with limited inrush power
- Mechanical and electrical signaling of overcurrent release trip
- Trip reset release
- Auxiliary contacts (status, connected/test/disconnected position, ready to close, spring charged), pre-wired, to a small wiring terminal block. The Auxiliary contacts shall be used to provide status on the local SCADA system.

The shunt devices and geared motor shall be suitable for 110 V DC operation. If applicable and where necessary, interlock system among circuit-breakers shall be provided. In addition, the interlock system of main circuit breakers shall consider the status and conditions of other associated systems in the PV farm to ensure safe operation of the system.

The air circuit breaker shall be equipped with electronic trip release. The protection ANSI 49, ANSI 51, ANSI 50 and ANSI 51N shall be provided and adjustable. A watchdog shall be available. The configuration of the unit shall be password protected. The electronic trip release shall also be able to export information, including indication of tripped protection after a fault, alarms and warnings among others, and receive command through the local communication bus.

6.9.3 Moulded Case Circuit Breakers

Moulded case circuit-breakers shall be constructed and tested in accordance with IEC 60947. Moulded case circuit-breakers shall have a rated service voltage of 690 Vac and a rated insulation voltage of 1000 V. The rated uninterrupted current and the rated short-time withstand current (1 sec) of the moulded case circuit-breakers shall be defined by the Contractor based on the design of the system. The moulded case circuit-breakers shall also be padlockable in open position.

The following accessories shall be available for the moulded case circuit-breakers:

- Shunt opening/closing release
- Auxiliary contacts for open, close and trip status, pre-wired, to a small wiring terminal block. The auxiliary contacts shall be used to provide status on the local SCADA.

The shunt devices shall be suitable for 110 V DC operation. If applicable and where necessary, interlocks among circuit-breakers shall be provided.

The moulded case circuit breakers shall be equipped with thermomagnetic or electronic trip units as required by the design of the system. The thermomagnetic trip unit shall be fitted with a protection threshold against overload and a protection threshold against short-circuit. The threshold setting of the thermomagnetic trip unit shall be adjustable. The electronic trip unit shall be self-supplied and shall provide protection against overload and against short-circuit with intentional delay. It shall be possible to adjust the trip threshold for the protection against short-circuit independently of the protection against overload.

6.9.4 Surge Protective Devices

Surge protective devices shall be suitable for the PV system in accordance with IEC 60364. The type, the discharge current and the impulse current of the surge protective devices for the AC system shall be defined by the Contractor and shall be submitted to the Employer for approval. The surge protective devices shall feature a local visual status indication and shall incorporate remote contact signaling to indicate normal operating state. In case of surge protective devices having the technology combining disconnection and short-circuiting device for safe electrical isolation in event of arcs, the status of the disconnection and short-circuiting device should also be made available remotely.

6.9.5 Fuses

Fuses and fuse holders shall be in compliance with IEC 60947-3. The rated current and breaking capacity of the fuses shall be defined by the Contractor in line with the design of the system. Each fuse shall be housed in a properly rated fuse holder with fuse status indication which shall be made available to the local SCADA system.

6.9.6 Measuring Device

All incomings and outgoing shall feature a digital multi-function meter which shall be interfaced with the local SCADA system. All digital multi-function meters shall be flush mounted, include digital displays of the following electrical parameters for all phases: Current (A), Voltage (V), Active Power (kW), Apparent Power (kVA), Reactive Power (kVAr), Kilowatt Hour (kWh), Kilovar Hour (kVArh), frequency (Hz), power factor, harmonic analysis (voltage harmonics, current harmonics, THD) up to the 50th order. All necessary instrument transformers, fuses and wiring, etc., shall be provided by the Contractor. The accuracy of the measuring device shall be 0.5.

6.10 Transformers

6.10.1 Outdoor Door Step Up Transformers

The outdoor step up transformers shall be fully rated in accordance with the Employer's Requirements. It shall comply with IEC 60076 and shall be suitable for installation outdoors in direct sunlight unless otherwise indicated. Full details of the transformers shall be finalized by the Contractor at detailed design stage where calculations shall be submitted to the Employer for approval. All alarms and tripping signals for transformers shall be individually connected to the PV Farm SCADA for control and monitoring.

Rated transformer LV voltage (which is the open circuit voltage as defined in IEC 60076) shall match 415 V.

Temperature rises shall not exceed the following magnitudes:

- Transformer Oil 60 ºK
- Windings 65 ºK

Table 6.4: Oil filled Outdoor transformers specification

Description	Unit	Requirement
Power Capacity	kVA	630 (To be finalised)
Cooling		ONAN
Rated Voltage	kV	24
System frequency	Hz	50
Off –load tap changers		± 2 ½% and ± 5% taps
22 kV System Short Circuit	kA	16

415 V System Short Circuit	kA	
High Voltage winding (Nominal Voltage)	kV	22
Low Voltage winding (Nominal Vintage)	kV	0.415
Winding Type		Enamelled Copper
Construction		Core type double wound or shell type
Vector Group		Dyn11

Each transformer shall be enclosed in a suitably welded steel tank such that the transformer can be lifted and transported without permanent deformation or oil leakage. The construction shall employ weldable structural steel of an approved grade.

Lifting lugs shall be provided, suitable for the weight of the transformer, including core and windings, fittings, and with the tank filled with oil. Each tank shall be provided with at least four jacking lugs, and where required, with lugs suitably positioned for transport on a beam transporter. The transformer tank shall be capable of withstanding full vacuum without deflection.

The transformer shall be of a sealed construction with a completely welded tank and covers welded on. Oil shall be sealed from the atmosphere by an inert gas sealing system or by the use of an internal gas cell. Provision shall be made for vacuum filling on site. The system provided shall include all auxiliary devices such as gas bottles, valves, controls, etc.

An approved pressure relief device of sufficient size for the rapid release of any pressure that may be generated in the tank and designed to operate at a static pressure lower than the hydraulic test pressure shall be provided. In the event that the device is a spring operated valve type, it shall be provided with two sets of normally open contacts for initiating alarm and trip circuits.

Corrosion resistant materials shall be used and the relief device shall be equipped with visual indication of operation. The relief device shall be mounted on the tank cover and shall be provided with a skirt to project at least 25 mm into the tank to prevent gas accumulation. Discharge of oil shall be directed away from the transformer top cover and clear of any operating position.
If a diaphragm is used, it shall be of approved design and material and located above the maximum oil level.

Visual indication of oil level shall be provided by a float whose position is transmitted magnetically to a gauge pointer, which shall be visible from grade.

The transformer shall be provided with an approved device for indicating the oil temperature at the hottest location. The dial type indicator shall have a pointer to register the highest temperature reached. A contact shall be provided for remote alarm/trip facility with adjustable set points.

A pressure-vacuum gauge shall be located on the side of the tank and shall be visible from grade.

In addition, the transformer shall have the following.

- Oil filling hole with plug
- Lifting lugs
- Earthing terminal for tank
- Drain plug with sampler cock
- Diagram and rating plate
- Terminal marking plate
- Supplied with detachable top yoke to allow removal of windings for repairs.
- Externally hot dip galvanised to BS EN ISO 1461.
- Designed for ground mounting with rollers.
- Designed with a bolted cover.
- Designed with the following terminations:-

(a) HT side -3 plug-in type bushings rated 200A, 24 kV suitable for the reception of elbow plug-in connector

(b) LT side - 4 bushings and associated copper cable terminals having the following characteristics:-

All relevant data shall be supplied where applicable by filling in the Schedule of Guaranteed Particulars – Sheet 5, and dimensional drawings of the transformer shall also be submitted.

6.10.2 Mineral Insulating Oil

The insulating oil shall be for use in transformers and shall comply to IEC 60296 and 60156 or equivalent.

The oil shall be free of PCB and be of such quality that it shall not require any user precautionary labelling as defined by the EEC Dangerous Substances Directive 67/548/EEC. Oil of Uninhibited Type is preferred.

The polycyclic aromatic content by IP 346 shall be maintained below 3%.

7.0 22 kV SWITCHING SUBSTATION

7.1 General

The 22kV switching substation shall provide the interface between the solar PV farm and the MV distribution network of the Central Electricity Board. The switching substation shall be of concrete type sized to accommodate a 22 kV indoor metal clad switchboard, as per Drawing No. R-GRE-EL02:

The 22kV indoor switchboard shall consist of the following switchgear panels:

Item	Panel Type	Qty
1	Incoming Feeder Panel (On-Load Switch disconnector)	3
2	Voltage Transformer	2
3	Single Isolation Circuit Circuit breaker	3
4	Bus coupler	1
5	Double isolation circuit breaker	2

7.2 22kV Switchgear Room

The 22kV switchgear room, housing the 22kV switchboard, shall be of reinforced concrete and air-conditioned to maintain the temperature at room temperature within a range of 17-22^{o}C and the level of humidity as per the recommendation of the manufacturer taking into consideration the environmental conditions in Grenade. The Air-conditioners shall be supplied and installed in an N+1 configuration.

The Contractor shall size the switchgear room to house the 22kV switchboard. The guide drawing for the switchgear room is as shown in drawing 6645-18. The design of the switchgear room shall be approved by the Employer prior to implementation.

In addition, the following points should be strictly adhered by the Contractor for the MV switchgear Room:

1. Cable glands of diameter 22mm shall be installed on the bottom of the Voltage Transformer and Circuit Breaker panels for the laying of all supervisory cables.
2. Provision of lighting system in the switchgear cabins. The lighting system will have to cater for emergency lighting in case of power cut.
3. Provision of a fire detection system in the switchgear room.
4. Symbols and labels for Danger/Live shall be affixed on the Switchgear room doors.
5. Fixing of rack for spare fuses PTs and CTs.
6. Fixing of HT switch handle support on wall.
7. Provision of padlock facility for switchgear room door.

8. PVC sleeves shall be placed at the corners of drawpits at deviation point of UG cables in order to allow for a larger bending radius whereas for straight running of UG cables, PVC sleeves should be placed at the centre.
9. After completion of all cable works and before commissioning of HT Switchgears panels, safety covers shall be fixed at all cable entry points under each switchgear cubicle in order to avoid entrance of rats or any animals from cable ducts as this may cause damages to equipment. The covers will be fixed by means of bolts.
10. The Air conditioning unit should be fitted with alarm/ monitoring device indicating any abnormal operation.
11. Cable support shall be provided inside the cable duct for both incoming and outgoing cables. The cable support shall comply with the requirements illustrated in Drawing No: 6645-18 & 6640-18.
12. Insulating mat shall cover the whole length of the switchgear panels.
13. The switchgear room should be painted and epoxy paint of blue colour should be used for floor finishing of the switchgear room.
14. The Contractor should provide a means for fixing the system numbers onto the front panels of the switchgear modules. The system numbers (e.g. B5044) would be provided by CEB before commissioning. The labelling of the system numbers shall be in the form of white gravoply plates 80mm length x 30 mm height with black letters 15 mm high. The gravoply plates shall then be glued at appropriate locations on the panels.
15. Provision of overhang or canopy and rooftop waterproofing should be carried out to prevent ingress of water into the switchgear room from the main doors and the roof respectively.
16. Appropriate measures should be devised to prevent any water entry through the cable duct. For instance, all openings le should be sealed with Sika Boom or equivalent.
17. A step ladder should be provided inside the CEB trench (below the checkered plates).
18. Provision of cable tray from upper LV control compartment to the electrical panel and control room.
19. Provision of an appropriate earthing and equipotental bonding system with visible earth bars and connection points.
20. Additional Protection and Safety Requirements

7.3 22kV switchgear Panels

The design of the switchgear board and associated wiring diagrams shall be approved by the Employer prior to ordering and construction. The substation installation shall, unless otherwise specified, be in accordance with the requirements of IEC 61936-1. The cubicles shall form one single switchboard.

The layout of the switchgear shall take into consideration the access requirements for operation and maintenance of the substation. It shall be noted that locking of disconnector/earthing switch mechanisms is required as part of the Employer safety procedures.

Switchgear panels shall be adequately labelled at the front and rear of the switchgear, these labels shall not be fitted on detachable doors or covers. A main label (identifying the switchboard designation) shall also be fitted in a prominent position. Labels shall be provided to show the Employer designation of each switching device

The design of the substation installation shall comply with all relevant Health & Safety legislation applicable in Mauritius.

Circuit labels shall be engraved on stainless steel labels, preferably black lettering on brushed stainless steel background. In addition, switchgear rating plates shall be provided with details engraved on a brushed stainless steel label.

The Contractor shall submit all relevant data of the proposed switchgears and associated equipment in the provided Technical Schedule List (Section 7 – Guaranteed Particulars). The Employer shall require all test certificates/ documents before commissioning of the 22kV switchgear panels. It is important to note that the 22kV switchgear room, switchgears, transformers and any material and equipment forming part of the switchgear room shall be approved by the Employer prior to manufacturing and ordering.

The 22kV switchgear and all 22 kV equipment shall comply with specific standards and with the IEC 60694:"*Common specifications for high-voltage switchgear and control-gear"*. The latter defines the normal conditions for the installation and use of such equipment. Condensation may be prevented by use of de-humidifying equipment. The Switchgear shall have anti-condensation heaters inside 22kV cubicles and let them run continuously, i.e. without automatic or manual control.

Switchgear shall be type tested in accordance with the requirements of the relevant IEC Standards. A summary of type tests shall be submitted with the tender. Copies of test certificates from an accredited short-circuit testing station covering the equipment offered shall be provided on request.

Routine tests (Factory Acceptance Tests) and tests after installation at site shall, as a minimum, be in accordance with the requirements of the relevant IEC Standards.

7.3.1 Electrical Characteristics

The 22 kV switchgear shall comply with the general requirements specified in IEC 62271-1 as detailed below:

Table 7.1: Technical Requirements for 22kV Switchgear

Description	Unit	Requirement
Nominal System Voltage	kV	22
Highest System Voltage for Equipment	kV	24

Rated Voltage	kV	24
Type of Installation		Indoor
Number of Phases		3
Rated Frequency	Hz	50
Rated Lightning Impulse Withstand Level (1.2/50 µs peak value)	kV pk	125
Rated Normal Current (Busbar)	A	630
Rated Normal Current (Feeder)	A	630
Rated Normal Current (Transformer Incomer)	A	630
Rated short-time withstand current	kA	16 (min)
Rated duration of short circuit	s	1
Rated peak withstand current	kA	62.5
Degree of protection (enclosure)		IP41
Loss of service continuity category		LSC2B
Class of partitions and shutters		PM
IAC Classification		Accessibility Type A (authorised personnel)
Type of Accessibility		AFLR
Short circuit current for IAC	kA	16
Short circuit duration for IAC	s	0.5
Particulars of the Operating Devices		
Type of operating device		Motor charged spring
Rated supply voltage		110 V DC.

7.3.2 Incoming Feeder Panel

The incoming feeder panel shall comprise of at least the following

a) Switch disconnector

The switch disconnector shall comply with IEC 62271-102 and should be fully insulated by SF6 gas. The switch disconnector shall be triple pole with integral fault making earth switch. The rated current of the switch disconnector shall be 630 A. The switch disconnector shall be capable of making on to a fault whose magnitude is equal to the specified short circuit level for 1 second.

The switch disconnector shall operate by means of a motor-operated spring-stored energy system, featuring a rapid acting mechanism, independent of the operator. The motor shall be suitable for 110V DC operation. The switch disconnector shall be operated either remotely from the SCADA System or locally. Mechanical indicator for “charged-discharged” position shall be provided. In the absence of auxiliary power supply, the

manual operation of the spring charging system shall be possible. The switch disconnector shall also be equipped with closing and opening coils suitable for 110V DC.

Auxiliary contacts shall be provided on the switch disconnector to indicate its status to the local SCADA system. The switch disconnector shall be equipped with a SF6 pressure switch with two (2) levels of alarms for low pressure and very low pressure respectively.

Mechanical indicators of the switch disconnector position shall be provided on the front fascia. A selector switch shall also be provided for the remote and local operation of the switch disconnector. Remote operation, through the SCADA system, shall be possible from both Grenade and Port Mathurin. The key interlocking system shall be release only in local mode. Push buttons shall be made available on the front fascia of the low voltage compartment for the opening and closing of the switch disconnector.

In addition to the above, the switchgear shall also be equipped with the following features:

- Manual spring operating mechanism in case of failure of the motor.
- Earthing switch located in such a position to allow its contacts to be seen easily through the cubicle window.
- Mechanical interlocking system between disconnector and earthing switch
- Cable compartment with cable terminations for the reception of 3-core Aluminium 240 mm² or copper 300 mm² XLPE cable to IEC 60502-2. The cable entry is to be at the front of the panel
- Bottom plate with cable gland
- Built-in padlocking device of the cubicle door

The front facia should be equipped with appropriate padlocking facilities that will allow the operator to lock the disconnector switch and earth switch in close/open position independently.

The Incoming 3-Core Power Cable shall be centered below the Panel Base / Bottom Plate and cable terminations (Indoor) shall be mounted inside the 22kV compartment of the incomer switchgear panel (refer to drawing 6645-18). Rubber bushings shall be provided for sleeve protection for cable of size ranging from 65mm to 100mm.

The front facia should be equipped with appropriate padlocking facilities that will allow the operator to lock the disconnector switch and earth switch in close/open position independently.

The load break switch disconnector shall have both local and remote modes of operation via a key selector switch which should be mounted on the front facia. The key should be released in local mode only.

b) Voltage presence indicator

The switchgear cubicle shall be equipped with voltage presence indicators according to IEC 62271-206. The voltage presence indicators shall allow the visualization of voltage presence on each phase with LED indication.

7.3.3 Voltage Transformer Panel

The cubicle for Voltage Measurement and Protection shall comprise of the following equipment:

a) 3-Position Disconnector

The 3-position disconnector shall be positioned between the DIN fuses and busbars. The 3-position disconnector shall be integral with fault making earth switches and shall be in one of three positions: "closed", "open" or "earthed". Mechanical indicators shall be provided for the switch position on the front fascia. Auxiliary contacts shall be provided on the 3-position disconnector to indicate its status to the SCADA system.

b) MV Fuses

The fuses shall be of the DIN type featuring striker pins, suitable for the protection of the MV/ LV transformer for auxiliaries. The rated voltage of the fuses shall be 24 kV. The rated current and the rated breaking capacity of the fuses shall be determined by the Contractor based on the rating of the MV/LV transformer for auxiliaries. The mechanical signaling and auxiliary contacts for blown fuses shall be provided to the SCADA.

Access to the fuses shall only be possible with the switch in the "Earth" position in such a way that both sides of the fuse are effectively earthed.

c) Voltage Transformers

The voltage transformers shall comply with IEC 61869-3 and shall be of the dry type. Three (3) single phase voltage transformers shall be provided for both protective relay and metering purposes.

The primary windings shall be connected through DIN fuses featuring striker pins. The mechanical signaling and auxiliary contacts for blown fuses shall be provided. Access to the fuses shall only be possible when both its sides are effectively earthed. Proper interlocking should be provided between upstream 3-position disconnector and the downstream control and protection device on the secondary side of the voltage transformers to prevent power infeed from the secondary side of the voltage transformer.

The metering core shall have an accuracy Class 0.2 and rated burden of not less than 10VA. The protection core shall have an accuracy class of 5P and a rated burden of not less than 15 VA. The burden calculation for the metering core shall be rated correctly to operate within the optimum range (i.e. between 0% and 100% of the rated burden). It can

be assumed that the maximum burden for the meter is 3VA per phase and secondly, the supervisory cable used is 1.5 mm^2 Copper cable. The contractor shall perform calculation for the burden, taking into consideration a spare capacity of 20%, to be submitted for approval prior to ordering.

The front facia should be equipped with appropriate padlocking facilities that will allow the operator to lock the disconnector switch and earth switch in close/open position independently.

Provision shall also be made to prevent or damp any ferroresonance effect in the voltage transformers.

Voltage transformers shall be designed so that saturation of their cores does not occur when 1.732 times normal voltage is applied to each winding. The ratio for the voltage transformers shall be as follows:

- Core 1: Metering Purposes : 22000/√3 : 110/√3
- Core 2: Protective Relay Purposes : 22000/√3 : 110/3 or 110/√3

Secondary circuits shall not be connected in parallel.

The voltage transformer secondary circuits shall be earthed at one point only and metal cases shall be separately earthed. Secondary protection (fuses and miniature circuit breakers) shall be provided as close as possible to each voltage transformer and labelled to show their function and phase color. Auxiliary contact shall be provided for the status of the secondary equipment.

All calculations for voltage transformer design shall be submitted to the Employer for review at an early stage, prior to manufacture. The test results of the VTs shall be submitted to the Employer for approval prior to implementation.

d) Voltage Presence Indicators

The switchgear cubicle shall be equipped with voltage presence indicators according to IEC 62271-206. The voltage presence indicators shall allow the visualization of voltage presence on each phase with LED indication.

7.3.4 Double Isolation Circuit Breaker Panel

The double isolation cubicle shall comprise of the following equipment:

- Circuit breaker of SF6 type
- Current transformers
- Voltage presence indicators
- Protection relay

a) 3-Position Disconnectors

The 3-position disconnectors shall be positioned in such a way as to provide double isolation of the circuit breaker from the busbars. The disconnectors can only be operated when the circuit breaker is maintained in open position. The 3-position disconnectors shall be integral with fault making earth switches and shall be in one of three positions: "closed", "open" or "earthed". The two (2) 3-position switch disconnectors shall be interlocked with each other. Mechanical indicators shall be provided for the switch position on the front fascia. Auxiliary contacts shall be provided on the 3-position disconnectors to indicate its status to the SCADA system

b) Circuit Breaker of SF6 Type

The circuit-breaker shall be of the SF6 type and shall comply with IEC 62271-100. The circuit breaker mechanical and electrical endurances shall be chosen from IEC 62271-100 in accordance with their duty. The rated current of the circuit breaker shall be 630 A. The rated short circuit current of the circuit-breaker shall be 16 kA, 1s.

The circuit breaker shall operate by means of a motor-operated spring-stored energy system, featuring a rapid acting mechanism, independent of the operator. The motor shall be suitable for 230 Vac. Mechanical indicator for "charged-discharged" position shall be provided. In the absence of auxiliary power supply, the manual operation of the spring charging system shall be possible. The circuit breaker shall also be equipped with opening, closing and tripping coils suitable for 110V DC.

Auxiliary contacts shall be provided on the circuit breaker to indicate its status to the SCADA system. The circuit breaker shall be equipped with a SF6 pressure switch with two (2) levels of alarms for low pressure and very low pressure respectively.

Mechanical indicators of the circuit breaker position shall be provided on the front fascia. A mechanical interlocking shall be implemented between the earthing switch and the triple pole isolator.

A selector switch shall also be provided for the remote and local operation of the circuit breaker. Remote operation, through the SCADA System, shall be possible from both Grenade and Port Mathurin. Push buttons shall be made available on the front fascia of the low voltage compartment for the opening and closing of the circuit breaker. In addition, the following test blocks shall be provided on the front fascia of the circuit breaker cubicle:

- One (1) voltage test block
- One (1) current test block
- One (1) trip test block

In addition, an interlocking system (electrical and key where appropriate) shall be provided to ensure proper operation of the PV Farm. The sequence of operation shall be finalised with the Employer prior to ordering and implementation.

c) Current Transformers

The current transformers shall comply with IEC 61869-2 and shall be of the dry type. The current transformers shall be provided for both protective relay and metering purposes. Toroidal current transformers will not be acceptable for metering purposes. Current transformers with split iron cores will also not be acceptable. The current transformers shall have dual primaries with current rating 50/100 A or as otherwise approved by the Employer. The secondary windings of each set of current transformers shall have a rating of 1 A and shall be earthed at one point only, through a bolted disconnecting link.

The maximum continuous rating of the current transformers shall not be less than 150% of the maximum continuous rating of the associated dry type transformers. The current transformers including primary winding conductors shall be capable of withstanding without damage the peak and rated short-time currents of the associated equipment.

The contractor shall perform calculation for the burden, taking into consideration a spare capacity of 20%, to be submitted for approval prior to ordering.

The rated volt-amp output of the current transformers shall not be less than the connected burden as installed in service, the burden of cable connections being taken into account. The output of the current transformers shall be not less than 10 VA with an accuracy limit factor of not less than 20 and the Contractor shall ensure that the capacity of the current transformers provided is adequate for operation of the associated protective devices and instruments.

The current transformers provided for protective relay purposes shall be used for combined overcurrent and earth fault protection of the inverse time-overcurrent type and shall have Class 5P20. The current transformers shall have overcurrent limit factors not less than those corresponding to the design short circuit level of the system. The current transformers provided for metering and instrumentation purposes shall have class 0.2.

The current transformers shall be solidly fixed using appropriate support structures. When double-ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformers, indicating clearly the connections required for each tap. The connections and the ratio in use shall be indicated on all connection diagrams.

Magnetization and core loss curves and dc resistance values shall be submitted for each type and rating of current transformers. The metering CT shall be mounted so that P1 is located on CEB side direction and P2 on client side direction.

In addition, the Contractor shall provide the Employer with the test results of all CTs for approval prior to implementation.

d) Protection Relays

The protective relays shall be of approved numerical multi-function type and shall comply generally with the requirements of IEC 60255. The protection relays shall be of the latest technology available, at the time of implementation, incorporating a wide range of protection and control functions as well as comprehensive communication facilities. The system shall be IEC 61850 compatible.

The protection relays shall include full programmable scheme logic, self-diagnostics and time tagged event recording (at least 100 events) to indicate the pre-fault currents and voltages by phase and maximum recorded analogue quantities. The protection relay shall integrate a user friendly interface for troubleshooting and local programming with password. The protective relay shall be suitable for flush mounting on the front fascia of the LV compartment.

The numerical relay shall comprise of two or more low set stages and one high set stage for both overcurrent and earth fault protection. Low set overcurrent and earth fault elements must consist of both Inverse Definite Minimum Time (IDMT) and Definite Time Stages. Relay must also provide both delayed and instantaneous overcurrent and earth fault high set elements.

In addition to neutral voltage displacement protection, the protective relay shall also offer two (2) independent over-current stages for phase elements (I>, I>>) and for earth fault (Io>, Io>>). The I>/Io> elements shall operate when the power frequency component of the current exceeds the set threshold. The time/current characteristic associated with these elements must provide a selection of inverse definite minimum time (IDMT) curves, or be settable to a fixed (definite) time delay. The relay shall be provided with a start function (and programmable relay output) that responds to the current exceeding either I> or Io> thresholds. The relay shall have both directional and non-directional functionalities.

The setting ranges for the overcurrent elements should be as follows:

- Low Set (I>):
  At Inverse time: 0.1In to 20In with time multiplier range: 0.025 to 1.5
  At definite time: 0.1In to 20 In with time range of 0s to 100s.

- High set (I>>):
  At definite time or instantaneous stage: 0.5In to 40In with time range of 0s to 100s.

The setting ranges for the earth fault elements should be as follows:

- Low Set (I>):

At Inverse time: 0.01In to 10In with time multiplier range: 0.025 to 1.5
At definite time: 0.01In to 10In with time range of 0s to 100s.

- High set (I>>):
  At definite time or instantaneous stage: 0.5In to 20In with time range of 0s to 100s.

- Neutral Voltage Displacement
  At Definite time : 1…. 20% x (22kV/√3)
  Operating time at Definite time: 0.05 ….. 20s

The auxiliary power supply for protective relays shall be 230 V DC. All protective relays supplied shall be tested on site. Proper facility shall be provided for the testing of protective relays and associated circuits. In case, injection test plugs are required for this purpose, the Contractor shall provide them.

The Contractor shall be responsible for providing to the Employer relay setting details for relays within his supply correctly coordinated with relays of other systems, where applicable.

A study report complete with curves illustrating co-ordination between new and existing systems along with all calculations to determine relay settings and CT and VT requirements shall be submitted to the Engineer for approval.

The Contractor shall provide the associated documentation, programming software and communication cables as part of his scope of supply. A communications menu system shall be provided in accordance with IEC 60870. A hard copy as well as a soft copy of the relay configuration, settings and manuals shall be submitted to the Employer after commissioning.

e) Voltage Presence Indicators

The switchgear cubicle shall be equipped with voltage presence indicators according to IEC 62271-206. The voltage presence indicators shall allow the visualization of voltage presence on each phase with LED indication.

7.3.5 Single Isolation Circuit Breaker Panel

The cubicle shall comprise of the following equipment:

a) Three-Position Disconnector

The 3-position disconnector shall be positioned between the circuit-breaker and busbars. The disconnector can only be operated when the circuit breaker is maintained in open position. The 3-position disconnector shall be integral with fault making earth switches and shall be in one of three positions: “closed”, “open” or “earthed”. Mechanical

indicators shall be provided for the switch position on the front fascia. Auxiliary contacts shall be provided on the 3-position disconnector to indicate its status to the SCADA system.

b) Circuit Breaker of SF6 Type

The circuit-breaker shall be of the SF6 type and shall comply with IEC 62271-100. The circuit breaker mechanical and electrical endurances shall be chosen from IEC 62271-100 in accordance with their duty. The rated current of the circuit breaker shall be 630 A. The rated short circuit current of the circuit-breaker shall be 16 kA, 1s.

The circuit breaker shall operate by means of a motor-operated spring-stored energy system, featuring a rapid acting mechanism, independent of the operator. The motor shall be suitable for 240 Vac. Mechanical indicator for "charged-discharged" position shall be provided. In the absence of auxiliary power supply, the manual operation of the spring charging system shall be possible. The circuit breaker shall also be equipped with opening, closing and tripping coils suitable for 110 V DC.

Auxiliary contacts shall be provided on the circuit breaker to indicate its status to the local SCADA system. The circuit breaker shall be equipped with a SF6 pressure switch with two (2) levels of alarms for low pressure and very low pressure respectively.

Mechanical indicators of the circuit breaker position shall be provided on the front fascia. A mechanical interlocking shall be implemented between the earthing switch and the triple pole isolator.

A selector switch shall also be provided for the remote and local operation of the circuit breaker. Remote operation, through the SCADA system, shall be possible from both Grenade and Port Mathurin. Push buttons shall be made available on the front fascia of the low voltage compartment for the opening and closing of the circuit breaker. In addition, the following test blocks shall be provided on the front fascia of the circuit breaker cubicle:

- One (1) voltage test block
- One (1) current test block
- One (1) trip test block

c) Current Transformers

The current transformers shall comply with IEC 61869-2 and shall be of the dry type. The current transformers shall be provided for protective relay purposes. Current transformers with split iron cores will also not be acceptable. The current transformers shall have dual primaries with current rating 50/100 A or otherwise approved by the Employer. The secondary windings of each set of current transformers shall have a rating of 1 A and shall be earthed at one point only, through a bolted disconnecting link.

The maximum continuous rating of the current transformers shall not be less than 150% of the maximum continuous rating of the associated dry type transformers. The current transformers including primary winding conductors shall be capable of withstanding without damage the peak and rated short-time currents of the associated equipment.

The contractor shall perform calculation for the burden, taking into consideration a spare capacity of 20%, to be submitted for approval prior to ordering.

The rated volt-amp output of the current transformers shall not be less than the connected burden as installed in service, the burden of cable connections being taken into account. The output of the current transformers shall be not less than 10 VA with an accuracy limit factor of not less than 20 and the Contractor shall ensure that the capacity of the current transformers provided is adequate for operation of the associated protective devices and instruments.

The current transformers provided for protective relay purposes shall be used for combined overcurrent and earth fault protection of the inverse time-overcurrent type and shall have Class 5P20. The current transformers shall have overcurrent and overcurrent limit factors not less than those corresponding to the design short circuit level of the system. The current transformers provided for metering and instrumentation purposes, where required, shall have class 0.2.

The current transformers shall be solidly fixed using appropriate support structures. When double-ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformers, indicating clearly the connections required for each tap. The connections and the ratio in use shall be indicated on all connection diagrams.

Magnetization and core loss curves and dc resistance values shall be submitted for each type and rating of current transformers.

d) Earthing Switch for Cables

The earthing switch shall be mounted in the cable compartment for cable earthing and shall be of the fault making type. Access to the cable compartment shall only be possible when the circuit is in earthed position. The earthing switch shall be mechanically interlocked with the integral earthing switch of the upstream 3-position switch disconnector.

e) Protection Relay

The protective relay shall be of approved numerical multi-function type and shall comply generally with the requirements of IEC 60255. The protection relay shall be of the latest technology available, at the time of implementation, incorporating a wide range of protection and control functions as well as comprehensive communication facilities. The system shall be IEC 61850 compatible.

The protection relays shall include full programmable scheme logic, self-diagnostics and time tagged event recording (at least 100 events) to indicate the pre-fault currents and voltages by phase and maximum recorded analogue quantities. The protection relay shall integrate a user friendly interface for troubleshooting and local programming with password. The protective relay shall be suitable for flush mounting on the front fascia of the LV compartment.

The numerical relay shall comprise of two or more low set stages and one high set stage for both overcurrent and earth fault protection. Low set overcurrent and earth fault elements must consist of both Inverse Definite Minimum Time (IDMT) and Definite Time Stages. Relay must also provide both delayed and instantaneous overcurrent and earth fault high set elements.

The protective relay shall offer two (2) independent over-current stages for phase elements (I>, I>>) and for earth fault (Io>, Io>>). The I>/Io> elements shall operate when the power frequency component of the current exceeds the set threshold. The time/current characteristic associated with these elements must provide a selection of inverse definite minimum time (IDMT) curves, or be settable to a fixed (definite) time delay. The relay shall be provided with a start function (and programmable relay output) that responds to the current exceeding either I> or Io> thresholds.

The setting ranges for the overcurrent elements should be as follows:

- Low Set (I>):
  At Inverse time: 0.1In to 20In with time multiplier range: 0.025 to 1.5
  At definite time: 0.1In to 20 In with time range of 0s to 100s.

- High set (I>>):
  At definite time or instantaneous stage: 0.5In to 40In with time range of 0s to 100s.

The setting ranges for the earth fault elements should be as follows:

- Low Set (I>):
  At Inverse time: 0.01In to 10In with time multiplier range: 0.025 to 1.5
  At definite time: 0.01In to 10In with time range of 0s to 100s.

- High set (I>>):
  At definite time or instantaneous stage: 0.5In to 20In with time range of 0s to 100s.

Any other protection required for the transformers shall be implemented by the Contractor.

The auxiliary power supply for protective relays shall be 110 V DC. All protective relays supplied shall be tested on site. Proper facility shall be provided for the testing of

protective relays and associated circuits. In case, injection test plugs are required for this purpose, the Contractor shall provide them.

The Contractor shall be responsible for providing to the Employer relay setting details for relays within his supply correctly coordinated with relays of other systems, where applicable.

A protective relay study complete with curves illustrating co-ordination between new and existing systems along with all calculations to determine relay settings and CT and VT requirements shall be submitted to the Engineer for approval.

The Contractor shall provide the associated documentation, programming software and communication cables as part of his scope of supply. A communications menu system shall be provided in accordance with IEC 60870. A hard copy as well as a soft copy of the relay configuration, settings and manuals shall be submitted to the Employer after commissioning.

f) Voltage Presence Indicators

The switchgear cubicle shall be equipped with voltage presence indicators according to IEC 62271-206. The voltage presence indicators shall allow the visualization of voltage presence on each phase with LED indication.

7.3.6 Test Certificates Prior to Commissioning

The following test certificates/documents shall be submitted to the Employer prior to commissioning of the HT switchgear panels:

1. HT switchgear certificates.
2. CTs & PTs certificates.
3. Transformer routine tests.
4. Earth resistance test on site, including method used. The Contractor shall submit Earth Test report for the earthing system of the medium voltage equipment, duly signed by a Registered Professional Electrical Engineer, and which include details such as weather conditions, equipment & methods used and the calibration certificate of equipment.
5. Protection relay tests on site.
6. HT cables Insulation & Pressure test certificate.
7. Proposed relay settings for approval by the Employer.
8. Valid Calibration certificates of the test equipment being used for pressure and relay tests. Only calibrated equipment shall be used during pre-commissioning tests such as Power-Frequency Withstand Voltage Test & primary injection/relay tests.
9. Hard and soft copies of the switchgear internal wiring diagram and complete electrical layout of HT and LV systems, both signed by a Registered Professional Electrical Engineer.

8.0 CABLING

8.1 General

The Contract shall include for the design, supply, manufacture, delivery and off-loading on site of the power and auxiliary cables, earth conductors and electrodes, accessories and associated equipment, laying, construction of raceways including concrete encased duct bank pre-formed concrete trenches as required, erecting, fixing, jointing, bonding, termination, connecting up, testing on site, setting to work and maintenance in accordance with the Conditions of Contract The supply, fixing and painting where required of racks, cleats, steelwork,

8.2 Current Rating and Cable Sizing

The Contractor shall submit calculations for sizing of all cables to the Employer for approval.

Sizing shall take account of continuous current rating, method of installation, short-circuit rating under fault conditions and voltage drop under steady state and transient conditions.

Cable rating calculations shall be carried out by the Contractor in accordance with IEC 60287.

If a proprietary software program is to be used for sizing of the cables, same shall provide details of the software program in his Tender.

The Contractor may use the data set out in this tender document for preliminary calculations. However, the Contractor shall be responsible for determining the actual ground thermal resistance by measurement at locations dictated by ground variations and levels along the route.

8.3 Site Conditions

Attention is drawn to the fact that cables which are run in underground ducts or preformed concrete cable trenches may be subject to continuous immersion in water.

The following data may be used for preliminary calculation of cable current ratings:

- Ground temperature at one metre depth of cover : 30 ºC
- Average thermal resistivity of soil : to be determined during Geothechnical Survey
- Highest maximum outdoor temperature : 38 ºC
- Average daily maximum ambient temperature : 28 ºC
- Maximum indoor average ambient air temperature : Contractor's design value.

8.4 Type Approval

Type test reports shall be submitted for approval during the engineering phase and cable design details and design drawings of each terminating accessory shall be included in the type test.

8.5 Cable Length

Cables shall be installed in the longest possible continuous lengths and straight through jointing between lengths will not be permitted unless otherwise approved by the Employer.

8.6 Cable Drums

Each cable drum shall bear a distinguishing number on the outside of one flange together with country of origin and year of manufacture. Particulars of the cable, i.e. voltage, conductor size and material, number of cores, type, length, gross and net weights shall also be clearly shown on one flange. The direction of rolling shall be indicated by arrows on both flanges.

8.7 Spare and Scrap Cable

All cable delivered to site shall become the Employer's property on completion of the Works.

Cut lengths of cable exceeding 10 metres in length shall be stored properly for future maintenance purposes.

All surplus cable lengths shall be individually tagged and labelled to include the cable type, size, length and voltage rating etc. All opened drums of cable and scrap cable shall be left in suitable storage location on site. The contractor shall ship any unopened drums of cable to his works.

8.8 Underground MV Power Cables

Cables shall comply with the relevant sections of IEC 60502-2 (22kV). The technical requirements are as follows:

Table 8.1: Technical Specifications for HV Cables

Description	Unit	22kV Cable
Nominal System Voltage	kV	22
Highest System Voltage for Equipment (U_M)	kV	24
Insulation Level	kV pk	125
Power transfer Capacity	MW	5 MW

3-phase short circuit fault for 1 second	kA	16

The metal sheaths and armouring of each solidly bonded or cross-bonded cable circuit shall be rated to carry the maximum calculated earth fault current. If this is not practical, a separate suitably-rated earth conductor shall be installed in parallel to the associated power cable.

In the case of solidly earthed neutral systems, the design shall be such that in the case of an earth fault current of 16 kA for 1 second the final temperature shall not exceed 150 ºC.

Each cable conductor shall be sized to carry the maximum earth fault current equal to the design three phase fault level for one second, and in the case of an earth fault current of 16 kA for 1 second the final temperature shall not exceed 150 ºC.

8.9 Cable Construction and Manufacture

22kV Cables shall be of single core construction and be designed to meet the thermal, electrical and mechanical requirements of the CEB system.

The proposed cable construction shall be agreed prior to Contract award.

8.10 Conductor

Conductors shall be constructed of either compacted, plain annealed copper strands strands conforming to IEC 60228 (Class 2) unless unless otherwise approved by the Employer.

Conductor shall be sufficiently sized to carry the 3-phase short circuit fault current of 16kA for 1 second.

Conductors shall be longitudinally water blocked between all interstices of the conductor and shall satisfy to the water penetration test requirements specified in IEC 60502-2 / IEC 60840.

8.11 Semiconductor Screen

A conductor screen shall comprise an extruded layer of semi-conducting compound which continuously covers the surface of the conductor. The screen shall remain fully bonded to the insulation during installation and operation.

8.12 Insulation

The insulation shall be XLPE material with suitable nominal and minimum insulation thickness conforming to IEC 60502-2 / IEC 60840. The XLPE insulation shall be capable of continuous operation at 90ºC.

8.13 Insulation Screen

The insulation screen shall comprise an extruded layer of semi-conducting compound which continuously covers the surface of the insulation of each core.

The insulation screen shall be strippable and for 22kV cable shall meet the test requirement specified in IEC 60502-2 clause 19.23, although shall show no tendency in service to separate from the insulation due to the effects of installation or operation.

The semiconductor screen, insulation and insulation screen shall be free of water and triple extruded in a single operation with the semiconductor screen and insulation screen fully bonded to the insulation. Following vulcanization dry cooling is preferred.

8.14 Water Blocking Tape

Swelling tape shall be applied over the insulation screen to provide longitudinal water blocking.

8.15 Metallic Screen

The cable shall be provided with a continuous metallic screen composed of helically applied plain annealed copper wire which shall be rated to carry the phase to earth short circuit fault current of 16 kA for 1 second.

8.16 Laminated Tape

An impermeable barrier to protect the cable from radial water ingress shall be provided over the metallic screen. Co-polymer laminated foil tapes for this purpose are acceptable.

8.17 Armour

On single core cables, the armour shall consist of either aluminium strip or other non-magnetic armouring as approved by the Engineer.

Multicore cables shall have a single layer of galvanised steel wires and single core cables shall have a single layer of aluminium wires laid on an extruded inner covering.

8.18 Cable Accessories

This section specifies the technical requirements for HV cables and accessories including terminations and joints. Unless otherwise specified or agreed, they shall be made by the cable manufacturer to ensure compatibility, reliability and responsibility.

The designed life of all cable accessories shall not be less than the associated power cables. Preference is given to longer life designs and minimum maintenance requests.

8.18.1 Cable joints

In general, the joint design shall be suitable for XLPE insulated cables with conductor sizes selected for the application. In addition, following minimum technical requirements shall be met:

The joint shall provide a sufficiently rated current connection between conductors under both normal and fault conditions. It shall have a resistance not exceeding that of an equivalent length of conductor.

The joint insulation shall meet the same performance standard as the cable.

The joint shall provide a high current connection to permit the flow of short circuit current between the two cable sheaths or screen wires (if applicable).

A metallic joint shell or screen wire connection, electrically insulated from earth potential, shall be provided to match the insulation integrity of the cable oversheath.

The joint and cable insulation shall be protected against the ingress of water.

The joint metal work shall be protected against corrosion.

The joint design shall confirm to IEEE 404 and the test requirements specified in IEC 60502-4 / IEC 60840. Preference is given to prefabricated joints (either composite type or pre-moulded type) and heat/ cold shrink sleeve joints.

All joints shall have the conductor surfaces tinned to prevent oxidization and shall be riveted and soldered, or where specially approved, bolted and soldered or welded. Each joint shall be permanently clearly labelled detailing the Feeder Identification, Joint Number and Joint Phase colour.

The jointing kit shall include splicing instructions and all necessary materials such as consumable material and other components to complete the jointing work. All materials of cable joints and its associated consumable equipment shall be environmentally friendly and do not cause any hazard to the personnel who are carrying out the termination work.

8.18.2 Cable terminations

In general, the termination design shall be suitable for 22kV, insulated cables with an appropriate conductor size. In addition, following technical requirements shall be met as a minimum:
The termination shall provide a sufficiently rated current connection from the cable conductor to busbars or cable box interfaces.

Insulation shall be to the same performance standard as the cable.

The termination shall assist in supporting the cable.

The termination shall be able to withstand cable thermo-mechanical loads and external forces such as wind and busbar loading.

The termination must provide a high current connection to permit the flow of short circuit current from the cable metallic sheath or shield wires via a bonding lead to the system earth.

A connection to the cable metallic sheath or earth wires shall be provided which is electrically insulated from earth potential to match the insulating integrity of the cable oversheath.

The cable termination shall protect the cable insulation and sheath against the ingress of atmospheric water and, where applicable, the ingress of pressurised dielectric liquid or gas.

Both indoor and outdoor termination design shall confirm to the test requirements specified in IEC 60502-4 / IEC 60840. Preference is given to heat/ cold shrink sleeve terminations for connections to air insulated equipment and separable type terminations for connections to metalclad equipment and transformers. The creepage distance across the weathershed of an external termination shall not less than 42 mm/kV based on the highest system line voltage.

Outdoor cable termination shall not be protected by arc gaps. If the cable is exposed to transient voltages, surge arresters shall protect the cable.

All terminations shall have suitable finishes, including metal coating, plastic coating, painting, inorganic treatment, etc., with high resistance to atmospheric conditions for metals liable to corrosion or rusting. Each termination shall be permanently clearly labelled detailing the Feeder Identification, Joint Number and Joint Phase colour.

The termination kit shall include splicing instructions and all necessary materials such as consumable material and other components to complete the termination work. All material of cable terminations and its associated consumable equipment shall be environmental friendly and do not cause any hazard to the personnel who are carrying out the termination work.

8.19 Cable Installation

This section specifies the installation requirements for HV cables and accessories. The installation shall be complete in every respect to allow uninterrupted use of the equipment installed and to ensure security of electrical supplies. Every precaution shall be taken to ensure that cables and accessories are not installed in a manner or under conditions likely to cause electrolytic or other corrosive action or damage to, or be detrimental to the performance of the cables and accessories during operation.

The installation shall be undertaken at all times by qualified staff and supplied with all the necessary plant, equipment and tools. The Contractor shall provide all the necessary material to complete the installation (incl. Site Acceptance Test). No welding, filling or plugging of defective parts during the installation shall be permitted without the approval from the Engineer.

8.20 Cable route

The Contractor shall be responsible for determining the cable route in agreement with the Employer.

8.21 Cable installation methods

All power cables shall be installed in pressure type PVC pipes of 160mm diameter complete with all necessary accessories and fittings as shown in drawings 6118-12, 6549-17 and 6550-17.

Each trench shall have vertical sides that, where necessary, have been timbered or otherwise secured to avoid subsidence and damage. Trench backfilling shall not be commenced until the Employer has inspected and approved the installation. Provision for at least two pressurized PVC pipes shall be made in every trench. .

Where cables are run in concrete cable ducts, all duct installations shall meet the mechanical requirements of the cable system. For road crossings, power cable shall be installed in ducts unless otherwise agreed. Following minimum technical requirements shall be met:

The internal bore and radius of any bends shall not be less than that specified by the cable manufacturer.

Non-magnetic duct materials shall be used for single core AC cable installations.

Duct joints, cable seals and duct mouth seals shall be designed to prevent the ingress of debris, other materials and vermin. No bentonite refilled is allowed.

Ducts shall have a smooth internal face and be brushed clean during installation.

Ducts must remain free of debris during and after cable installation.

A concrete duct bank shall be considered where enhanced mechanical protection is required, e.g. road crossings with a minimum concrete strength grade C20/25, or to improve the cable rating. In case of stream crossing, the ducts must be pressure type PVC pipes along the structure for stream crossing. A proposed design shall be submitted to the Employer for approval.

During installation, a draw line, or pulling wire, shall be in installed. This draw line shall be made of a corrosion proof material and have a service live no less than the power cables. When the cable is not drawn in immediately, the ends of the duct shall be sealed. For trefoil

formation, three single ducts shall be used. Power cable and associated pilot cables shall be in separate ducts.

For long duct runs where it may be necessary in the future to locate sheath faults, the installer shall demonstrate that a technique exists that would enable the location of a sheath fault to within a 6 metre length.

Provision of drawpits shall be made at regular intervals for ease of pulling of cables and replacement of same in the future. In addition, the contractor shall implement cable trenches under or next to the transformer and switchgear for cable entry. It is to be noted that the drawpits within the PV Farm shall have raised plinth with hinged galvanized heavy duty steel cover. The layout of the drawpits and cable trenches shall be approved by the Employer prior to implementation.

Control cables shall be installed in pressure type PVC pipes not less than 80 mm diameter. Two spare pipes shall be installed in each trench for future extension.

8.22 Cable pulling and bending

A cable pulling calculation, conforming to AEIC CG5, shall be submitted to the Employer for approval before cable laying activity starts, when requested. During the laying, power cables shall be pulled over sufficient rollers and particular attention shall be given to the provision and placing of rollers at bends, to ensure that the minimum bending radius required by cable manufacturer is not exceeded.

The cable shall not rotate or twist during the laying in any circumstance, as a result of excessive pulling tension and/ or insufficient rollers. Except for short route lengths, the pulling tension shall not be borne by the cable conductor through the application of double-thimble stockings or pulling eyes wherever possible.

8.23 Cable supports

The Contractor shall supply and install all the supports, e.g. racks, trays, cleats, clamps, saddles, etc. required to carry and secure the cables, without risk or damage. The nominal support interval shall be, unless otherwise agreed, 1m for rigid fixing and 5m for flexible fixing.

The design of cable supports shall be suitable for either trefoil or flat cable formation and free of rough edges, burrs and sharp corners. No materials shall be supplied which will cause corrosive impact in contact. Cleats and/ or cable straps for single core cables shall be non-magnetic and be suitably spaced to withstand forces and prevent damage to the cable during normal and short circuit conditions.

The design of cable supports for in air installation shall consist of vertical steelwork at approved intervals and secured to walls, floors or ceilings, etc. The steelwork shall be

designed to support a total weight no less than 125% of cables and metallic fixings combined, plus an additional 100kg load at the extremity. The steel used in construction of cable supports shall be galvanized.

Where cables are installed in cable galleries, consideration shall be given to the need to access this area without climbing on live cables. The Contractor shall propose a suitable design solution to meet this objective.

Cable trays used on fields for DC and AC cables shall be UV resistant, of Unex type or equivalent. The cable trays shall be covered. Where cable ladders are used, same shall be of hot dip galvanized type.

8.24 Cable bonding

Unless otherwise agreed, the cable system and metallic cable ways shall be fully bonded.

8.25 Short circuit current carrying capacity

The cable system design shall be such as to ensure that there is a continuous metallic return path of adequate cross section for the short circuit currents. Except for connections to SVLs at unearthed positions, the link connections and bonding leads shall be capable of carrying the specified short circuit currents without sustaining any permanent damage.

8.26 Cable earthing

Cable earthing system design shall meet the following requirements:

1. To ensure mechanical strength and corrosion resistance.
2. To withstand the maximum potential fault current.
3. To avoid damage to property and equipment.
4. To ensure personal safety by limiting earth potentials.
5. Cable sheaths shall be bonded to the substation earthing system.

8.27 Sealing and Drumming

Before dispatch, the Contractor shall cap the ends of all cable in order to form a seal to prevent the ingress of water during transportation and storage.

Where there is risk of stored charge building within the cables due to re-charging after factory acceptance test, conductive connections will be made between the metallic screen and the conductor underneath the seal.

The cable shall be supplied on steel drums, suitable for outdoor storage at the manufacturer location or the project site for a minimum period of two years.

Cable on drums shall be protected from damage with plastic wrapping and timber lagging/battening. Drum capacity shall be managed effectively and sufficient room shall be allowed for avoidance of timber lagging nails damaging the cables.

One length per drum is preferred for reasons of practicality and should an alternative arrangement be considered then this shall be agreed with the Engineer.

Each drum shall bear the manufacturer's contact information and labelled with a unique distinguishing ID number on the outside of the flange and particulars of the cable, i.e. voltage, length, conductor size and cable type.

The drum weight and gross weight shall be shown and the direction for rolling shall be indicated by an arrow.

8.28 PV Plant LV Cables

The cables used in the PV plant must be able to stand, for the whole life cycle of the plant (i.e.25 years), severe environmental conditions in terms of high temperatures, atmospheric precipitations and ultraviolet radiation. Cables specially designed for Solar PV installations shall be used and the cables shall be of armoured type.

The cables on the DC side of the plant shall be single core and have double insulation (class II) so as to minimize the risk of earth faults or short circuits in accordance with IEC 60364-7-712.

Over-ground cables such as module cables and string cables need to be properly routed and secured to the mounting structure using dedicated cable ladders and cable ties. All 90 degree bends shall be long sweeps installed in accordance with standard industry practices. Cables should be protected from direct sunshine, standing water and abrasion by the sharp edges of support structures. The selection and sizing of the cable should consider the maximum temperature (80 ^{0}C), maximum voltage of the PV strings or array, the maximum current (taking into consideration the various derating factors), maximum reverse current.

The use of specialized plug and socket connections on the modules are required so as to facilitate assembly. These plug connectors shall provide secure and touch-proof connections and are to be correctly rated (voltage and current), at least equal to those of the circuit they are installed on and IP 67. Connectors should carry appropriate safety signs that warn against disconnection under load.

The DC cables, steel wire armoured, should be sized so as to reduce losses and overall voltage drop between the PV array and the inverter to a minimum. Underground DC cables shall be run in pressure type PVC pipes. The LV cables shall have a separate routing from that of the 22kV power cables.

The AC cabling systems should be designed to provide a safe and cost-effective means of transmitting power from the inverters to the transformer(s) and beyond to the 22 kV

switchgear panel. Cables should be properly rated for the correct voltage and have conductor sized, taking into consideration the operating currents, short circuits and losses within acceptable limits.

Where underground cables are allowed, it shall be mapped and identified along their entire run with hazard tape and warning slabs, 50 cm. above the cable elevation and 50 cm below finish grade elevation.

No underground cable splicing shall be acceptable under any circumstances.

Only multi-stranded copper wires with XLPE insulation, of appropriate size and of reputed make shall be used. Aluminium cables shall not be accepted for low voltage installations within the PV farm.

All connections are to be made through suitable cable lug or terminals; crimped properly & with use of cable glands.

8.29 Cable Marking

All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified. Any change in cabling schedule/sizes if desired by the Contractor need to be approved after citing appropriate reasons at design stage. All cable schedules/layout drawings have to be submitted to the Employer prior to installation.

8.30 Installation of Optic Fiber Cables

Optical fibre cable shall be of the single mode type equipped with at least 16 fibres, complying with CCITT recommendation G652. All fibres including spares shall be terminated and connected in patch panels and labelled accordingly at both ends.

Fibre optic cable shall be provided with steel armour, which shall in turn be protected by an extruded outer sheath. Fibre optic cable shall be suitable for direct buried. Such cables shall be tested in accordance with ITU-T G.652 and IEC 60793 as appropriate.

Prior to installation, the optic fiber cable shall be tested with an OTDR on each fiber to ensure that no physical damage has occurred to the fiber during delivery and shall be compared with the results prior to dispatch.

After installation, the above test shall be repeated to ensure that no damage has occurred to the fiber during installation.

An end-to-end attenuation measurement shall be taken in each direction on each fiber using an optical source and optical power meter. The overall attenuation of the installed cable shall not exceed that calculated using the attenuation and splice loss values specified by the fiber optic cable manufacturer at the bidding stage.

The communication system between the different components of the PV Farms and the local SCADA system shall be via fibre optic. A fibre optic network shall be established.

The optical fibre within the farm shall be installed undergrounded in PVC pipes. The Contractor shall install a ring optical fibre network linking the different transformer. The optical fibre network shall comprise of at least 32 fibres.

The Contractor to ensure that the design cater for future extension of the PV Farm.

8.31 Documentation

Project documents as specified below shall be delivered as part of the Contract. The submission of documents specified here is a minimum requirement. The Employer reserves the right to request additional documents where the information available does not give enough evidence to show the technical details, functions, interfaces, capabilities of the equipment. These documents shall be provided at no additional cost.

The following documents shall be submitted as a minimum requirement. The provision of these documents is to be covered by the contract price.

- With Tender (together with additional documents listed in Requirements for cable accessories and installation)
- Cable cross section drawings
- Cable technical schedule (as per format provided)
- Rating calculation under both continuous and fault conditions
- Test certificates
- Preliminary cable work programme
- Preliminary cable bonding diagram

After Contract Award (together with additional documents listed in Requirements for 22kV cable accessories and installation)

- Certification letter of compliance with the specification
- Manufacturing test programme
- Prequalification test report(s)
- Type test report(s)
- Factory acceptance test report(s)
- Cable/Accessory delivery programme
- Detailed cable work programme
- Detailed cable route drawing, including existing services along the route, locations of joints, link box chamber, communication chamber, major road crossings, crossing arrangement with other services, and future access points/ routes for maintenance and repairs
- Survey reports and drawings

- Detailed cable rating calculation as per requested (continuous, cyclic, emergency, fault) under proposed installation conditions.
- Bonding/ Earthing schematic drawing including phasing

All other information necessary for a full understanding and evaluation of the project shall be included.

The contractor shall comply with the following obligations in relation to the submission of any documents, including but not limited to correspondence, drawings, calculations, letters, method statements, and programmes:

- All Documents shall be submitted in both hard copy and electronic form;
- Three hard copies of all documents shall be submitted;
- Drawings for approval shall be submitted in one copy of paper prints and, after having been approved, the Tenderer shall supply any further copies required by the Employer, one copy at least on a digital media in AutoCAD format or other agreed 3D format.
- Only electronic copies shall be submitted to the project document management system.
- All drawings shall be to scale and fully detailed. All-important dimensions shall be given and the material of which each part is to be constructed shall be indicated.
- The drawings provided as input data for the substation civil design shall be provided as a 3D model suitable for use by internationally accepted and used 3D design software packages.

8.32 Inspection and Test

8.32.1 General

The cables and accessories shall be fully tested in compliance with IEC 60502-2 / IEC 60502-4 / IEC 60840.

The Engineer shall retain the right to witness all relevant tests and a notice shall be given no less than 21 days prior to the test. A complete test programme shall be submitted no less than 14 days prior to the scheduled test. A report with all the results shall be submitted for review following each test.

All cables tests and measurement methods should conform to IEC 60502.

The cables shall comply with the following:

- Multi Strand, annealed high conductivity copper conductor
- XLPE extruded insulation
- Armored cable for underground laying
- All cables shall conform to IEC 60502, IEC 60364, IEC 60332-1-2
- The size of each type of cable shall be selected such that the maximum voltage drop is limited to 2%.
- Proper laying of cables have to be ensured in appropriate cable trays, pipes / trenches.
- A.C. supply cables shall be terminated at the AC Distribution Board.
- For termination of cables, latest IEC codes / standards must be followed.

Together with the type test certificates, evidence shall be submitted showing the type test has been executed at an internationally recognized testing station or in the Contractor's own facility, witnessed and certified by an international certification body.

The following additional tests are required on the cables:

- Fire resistance test, conforming to IEC 60331
- Low smoke test, conforming to IEC 61034
- Halogen content test, conforming to IEC 60754

8.32.2 Factory acceptance test (FAT)

The Factory Acceptance Test for 22kV cable shall consist of Routine tests and Sample test, conforming to IEC 60502-2 clauses 16 and 17 as the minimum requirement.

Factory Acceptance tests for accessories shall be in accordance with the requirements of IEC 60502-4 / IEC 60840.

Reports should be submitted to the Engineer for review and approval within 14 days following the completion of routine testing and sample testing.

The sample test shall be carried out on one length from each manufacture batch of the same type and cross-section of cable, covering minimum 10% of the number of lengths in contract unless otherwise agreed. The test frequency and minimum requirements shall conform to section 17 of IEC 60502-2 / IEC 60840.

8.32.3 Site acceptance test (SAT)

After the completion of new cable installations, the Contractor shall perform testing in conformance with section 20 of IEC 60502-2 / IEC 60840.

Unless otherwise agreed, an a.c. power frequency test shall be performed for 15 minutes in accordance with IEC 60502-2 clause 20.3.1 option a) or IEC 60840 as appropriate. All test equipment and access arrangements shall be provided by the EPC Contractor.

Partial discharge shall be monitored during the a.c. power frequency test in accordance with IEC 60270 with background noise suppressed to a level as low as reasonably practicable.

9.0 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

9.1 General

The Contractor shall make provision for a PLC based plant controller, SCADA System and two work stations in the Control Room of the PV farm. It should include all protection, control and instrumentation equipment necessary to permit safe and efficient operation of the PV Farm. The system shall be designed using manufacturer's standard hardware and software modules. The application software shall conform to IEC 61131. The acceptance of specialized or modified system modules shall be subject to the approval of the Employer.

A laptop with all appropriate hardware, firmware, and software shall also be provided for the on-site and remote monitoring, operation and maintenance of the PV farm. The SCADA system shall compose of an integrated operator human-machine interface (HMI), input/output (I/O) modules and appropriate hardware, firmware, and software. Internal control/communications devices designed to industry standards shall provide for remote monitoring, alarm management, control and historical trending of the monitored equipment. For the control and monitoring of the PV farm via the local SCADA system, a ring optic fibre communication network shall be installed to connect all inverters and measurement devices amongst others.

In addition, the Contractor shall install a workstation in Port Mathurin Power Station complete with software, hardwares and communication equipment for remote monitoring and control.

The Contractor shall take into consideration, during design, for future extension.

A local server for the PV Farm control system shall be provided and equipped with the latest hard drive technology with RAID1 (mirroring) or better, with a capacity of not less than 1 TB.

Basically, this SCADA system shall monitor and display the following information on the work station:

- The overall electrical schematic diagram of the electrical system complete with status and on-line electrical parameters
- Represent the farm geographically complete with monitoring parameters as described below.
- Measurement & continuous acquisition of ambient air temperatures and solar irradiations PV module temperature representative for each string,
- Measurement and/or recording of instantaneous power and energy parameters for each set of individual strings.
- Individual string current, inverter input voltage and current, inverter output voltage and current, output frequency and total harmonic distortion.
- Generation of yield reports detailing individual string performance and flagging those which are under-performing.

- Operating state monitoring and failure indication.
- UPS and DC supply status and alarms
- Representation of monitored data's in graphics mode or in tabulation mode.
- Monitor and store data from the Project Site meters on an interval from between five (5) to twenty (20) seconds.
- Positions circuit breakers, isolators and earth switches for both voltages and currents of the 22kV switchboard.
- Transformer status
- Plant LV& MV switchgears status and alarms
- Power and energy to and from CEB grid

The following will make up the SCADA Calculated Values List:

- Model vs Actual Performance in kW and kWh
- Day's energy in kWh
- Month's energy in kWh
- Year-to-date energy in kWh
- Total lifetime energy in kWh
- Performance Ratios
- Facility Performance Ratio, current value
- Facility Performance Ratio, day's average
- Facility Performance Ratio, month's average
- Facility Performance Ratio, year-to-date average
- Facility Performance Ratio, average since commissioning.

All monitored plant electrical generation equipment (e.g. inverters, transformers, battery systems, UPS, switchgear) shall be monitored to capture the diagnostic information including:

- Temperatures
- Alarms
- Status indicators
- Fault states
- Fire Alarm systems

In addition, the PV Farm operators shall be able, from the local SCADA, perform remote operation of at least the following:

- 22kV Circuit Breakers in Switchgear room.

The Contractor shall have to provide necessary hardware & software. Both the software and hardware required for interfacing the plant including modems, printer, UPS, are to be supplied and installed by the Contractor.

The SCADA System shall have one-year minimum on-site storage capacity for high resolution data.

9.2 Software

All of the required software for PV Farm operation, testing and commissioning shall be provided by the Contractor with **permanent** licenses that shall be registered in the name of the Employer and all software and **as-built** application programmes shall be handed over to the Employer in soft copy form. All necessary details concerning the software that has been used on site during testing and commissioning shall be advised by the Contractor to the Employer in timely manner.

All programming device, communication cables, list of plant set values, license certificates and other accessories that have been used to commission the equipment, shall be handed over to CEB for their subsequent use.

9.3 Remote control and Monitoring

The Contractor shall describe and provide a web based secure external communications link to provide the Employer access to all data acquisition and real time performance monitoring.
The PV Farm control system shall have the provision for installation of Ethernet communication link so as to enable remote control and monitoring capability via a personal computer and mobile phones. All parameters, status and indicators and targets accessible through the local operator interface may be accessed remotely through these ports.
The System shall be designed for communication via a fiber optic link which will be implemented by CEB in the future.

9.4 SCADA System Security

The Operator shall be provided with security access to specific system functions and data acquisition. Different access levels shall be configured on the SCADA system via passwords (Administrator and Operators among others).

9.5 Operator Desk

The Contractor shall provide a workstation/operator desk of appropriate size to accommodate two PC workstations complete with 19'' high resolution screens. The workstations/operators desks shall be ergonomically designed and shall accommodate the data terminal equipment towers within the enclosure of the lower portion of the desk. Data terminal equipment towers and Ethernet switches shall not be directly exposed to dust, water or mechanical stress. Communication and power cables to the equipment towers shall be properly and safety routed inside the operators desk. Two heavy duty office swivel chairs shall also be provided.

10.0 UNINTERRUPTIBLE POWER SUPPLY AND DC SUPPLY

10.1 General

Essential AC. supplies shall be provided from an uninterruptible power supply unit (UPS). The UPS shall feed a 230 V a.c. switchboard for distribution to essential systems. UPS system shall include a static bypass switch and an external maintenance bypass switch.

UPS systems shall be full on-line double conversion type and shall comply with IEC 62040 and IEEE 944.The UPS shall have at least adequate capacity for a minimum of 4 hours autonomy at full load and battery life of at least 7 years.

The UPS must have modular architectures based on identical power modules which can be interchanged and connected in parallel, inside the UPS cabinet. Similarly, also batteries must be contained in battery modules (Battery drawers) identical and interchangeable, to be installed in the system in series and parallel in order to obtain the correct battery voltage and required back up time

Power modules shall be equipped with control and self-diagnostic circuits, in order to easily individuate the faulty module and the specific failure inside it. In the event when battery drawer is removed from the cabinet there shall not be dangerous voltage for the user (dangerous DC voltage are bigger than 50V as indicated in the EN60950 standard). Either Power Modules or Battery drawers must be light in order to be managed, in service and maintenance, by only one person.

UPS system shall be installed in the Electrical Annex. The UPS shall be sized to allow operation during loss of supply. The control systems of the Solar PV Farm shall remain energize and operational during loss of main supply.

10.2 Redundancy

The kind of redundancy required must guarantee continuous supply and protection whenever one module fails. Redundancy must be obtained through the load sharing technology.

The architecture of the UPS must be parallel distributed, to be more precise, the load shall be shared between all power modules in each phase. In this way, during normal run, no power module is inactive or in standby. In a redundant configuration, if one module fails all the others ones will take the relevant load without any interruptions or transfer time at the output of the UPS. In case one module failure the power is guaranteed by the others modules.

10.3 Scalability

The modularity of the UPS must allow the increase of the back-up time on site, simply by adding battery drawers. The upgrade shall not require factory modifications and shall not need dedicated special tools.

10.4 Power Modules

Each Power Module will be composed by following functional blocs:

- Inverter
- Booster
- Battery Charger
- Rectifier/PFC
- Automatic Bypass

10.5 Batteries

The maintenance-free stationary Nickel-Cadmium batteries are housed in the UPS and/or in one of more cabinets of the same shape and size as that of the UPS itself. The positive and negative battery connections are protected by an adequate fuse-holder isolating switch.

10.6 Command Board

The Command board must be equipped with microprocessor of suitable computation power. This command board must manage all functions of the UPS and will execute the following jobs:

- automatic recognition of the number of connected modules;
- automatic setting of the maximum reactive power that can be provided on the output;
- individual serial communication with the power modules by a dedicated line;
- recognition of a faulty module and diagnosis of the relevant fault;
- synchronization of the output voltage with the input voltage;
- generation of a reference sinewave curve to form the output voltage wave;
- control of the PFC, inverter and booster circuits in each power module;
- management of the automatic bypass;
- management of the battery runtime (see relative section);
- management and recognition of the signals and measurements from each module;
- management of the user interface (see relative section);
- management and memorizing of UPS history parameters and data;
- alarm and events memory with association of the time and date of the events themselves.

10.7 110 V DC System

110V DC system shall comprise the following:

- Three (3) 400V / 230V ac to 110V DC rectifiers.
- 110V DC Nickel Cadmium battery set with an Autonomy of at least 6 hours at full load.

Rectifiers

The rectifiers shall be arranged such that they operate in parallel and each is operating at no more than 33% of its rated capacity. In the event of failure of two converters, the remaining one shall be rated to carry the full load.

The rectifiers shall comply with the requirements of IEC 60146 and IEC 61204.

The rectifiers shall be installed indoor and cooled by natural air circulation or forced ventilation. In this second case the ventilation failure shall be locally and remotely signaled.

The rectifier and battery charger shall be designed for automatic operation in "floating mode" and "charging mode".

The floating and charging voltage values shall be defined by the Contractor in accordance with NI-CD battery characteristics, and the voltage regulation shall take into account battery temperature.

The rectifiers' steady state and transient performances shall be chosen in accordance with IEC 61204.

The rectifiers shall be sized to withstand without tripping the expected transient overloads.

The multi module rectifiers operating in parallel shall be identical and shall have the same general characteristics as those specified in the previous paragraphs.

The rectifiers used as battery charger shall be sized to simultaneously supply the VDC loads and to charge the battery.

The rectifiers shall be equipped with filters necessary to limit the harmonic pollution in accordance with the requirement of IEC 61000.

The rectifier shall be housed in a freestanding steel-sheet panel, equipped with a pivoting and lockable door, with lifting lugs and provisions for fixing to the floor.

The rectifier shall include a dry-type isolating transformer compliant with IEC 60076 and IEC 60146.

The rectifier shall include over-current and over-voltage electrical protections and the electrical protections necessary to detect abnormal operation of the power converter.

These systems would allow operation in case of a first fault to earth and the relevant main distribution switchboards will be equipped with an on-line insulation measurement system.

The rectifier design shall allow the Operation Personnel to perform all control-command operations without opening the rectifier panel door.

Signals, alarms and measurements shall be displayed on the panel front.

110V Battery Set

The accumulator cells of the batteries shall be of the maintenance-free stationary Nickel-Cadmium.

The batteries shall comply with standard IEC 62259 and IEC 60623 and shall be manufactured in accordance with ISO-9001 & ISO 14001 standards.

The batteries shall comply with EN 50272-2 / IEC 62485-2.

The battery installation shall comply with IEC 62485-1 (or EN50272).

Each battery set will have internal battery autonomy of, at least, 2 hours (full Ah loading).

The Batteries shall be installed inside an enclosure or cabinet.

The battery shall be also designed to provide and withstand discharge peak currents (if any) and the necessary short-circuit current for a time duration superior to the protection trip time.

10.8 24V DC and 48V DC System

24 V and 48V d.c. system, where required, shall be derived from the 110 V d.c system using a set of three DC / DC converters arranged such that they operate in parallel and each is operating at no more than 33% of its rated capacity. In the event of failure of two converters, the remaining one shall be rated to carry the full load.

10.9 AC Switchboard

An essential service distribution switchboard shall be incorporated in the cubicle for the UPS system. This distribution board shall meet the requirements as described section below. A manual bypass switch shall be provided to enable isolation of the UPS for maintenance.

Distribution switchboards shall comply with IEC 61439 and IEC 60947. Distribution switchboards shall be type tested in accordance with IEC 61439 and IEC 60947. Type test certificates shall be sufficient to meet this requirement.

11.0 EQUIPMENT PROTECTION

The electrical design shall include the design of equipment earthing (grounding) and lightning and surge protection for the entire PV Plant site. The detailed equipment protections are described below:

11.1 Lightning Protection

The Contractor shall design, supply, install, test and commission a lightning protection system, materials and components fully in compliance with IEC 62305. The Contractor shall use the services of a specialist lightning protection company to design the lightning protection system. The Tenderer shall provide details of his proposed solution in his Tender.

The Contractor shall provide air terminals, bonding plates, conductors, connectors, conductor straps, fasteners grounding rods, and rod clamps and other components required for a complete system that meets the requirements of IEC 62305. Lightning protection shall be designed and provided in accordance with Protection Class LPS III of IEC 62305 for the entire Solar PV system.

Ground rods shall be 20 mm minimum diameter by 3 meters long, copper clad steel, molecular bonded with minimum 27 percent of the rod weight in the copper cladding.

Conductors shall be installed with a direct path from air terminals to the ground connection avoiding sharp bends and narrow loops.

The Contractor shall use approved C-clamps for all conductor splices and for all connections between conductors and other components.

The control system DC supply shall be protected via appropriate lightning and surge arrester modules.

Adequacy of the lightning protection system coverage shall be demonstrated by the rolling sphere method using a proprietary software package. Lighting protection study reports shall be submitted for review and approval by the Employer.

At least two (2) earth connections shall be provided for the PV metal frames, each bonded to earth electrodes.

11.2 Surge Protection

Internal surge protection shall consist of three surge-arrestors connected from positive and negative terminals to earth (via Y arrangement).

11.3 Earthing

The Contractor shall design and install an earthing system in accordance with the latest edition of IEEE 80 to achieve touch and step potentials within safe limits.

The continuity of the earthing grid shall accommodate the thermal and mechanical stresses caused by any fault current which may arise.

The earth grid shall consist of a combination of bare copper conductors and driven earth rods. Earth rods shall be driven into the ground for a depth of no less than 3 m and shall be at least 12 mm diameter and may be of either copper or copper clad steel. The main grid conductor shall be bare copper conductor, having a cross section area calculated for the maximum earth fault current for 1 sec. and a final conductor temperature not exceeding 150°C.
Interconnection of all equipment and main earth bars shall be by means of PVC insulated copper conductor of cross sectional area sufficient to carry the prospective fault current for 1 second with due allowance for specified future extensions.

Earth bars shall be provided in the switchgear rooms for connecting MV and LV switchgear to earth. In addition, an earth bar shall be provided adjacent to the surge arresters and all transformers for connection of these items to earth.

All major items of electrical equipment under this contract shall be bonded to the earth bar at no less than two locations. Such major items of equipment are PV modules, switchgear, transformers and inverters.

All earth bars shall be connected to the main earth system at two points.

Where parallel earth conductors are provided to accommodate the full earth fault rating of the circuit, fault current sharing shall be based on no greater than 60% of the rating of the individual conductor.

Conductors for bonding of cable ladders shall be bare. Continuity shall be ensured by means of a continuous length of conductor for each run of ladder or tray or by means of flexible straps at joints between sections.

Pipework, other than PVC, supplied under this Contract shall also be bonded in an approved manner.

Earth connection to surge arresters, transformer neutral points shall be made direct to the nearest group of earth rods and interconnected to the remainder of the earth system, using conductors of adequate current carrying capacity.

Connections between equipment and earth bar shall be made by means of lugs compressed onto the copper strands, using the appropriate materials. Connections which depend upon solder shall not be used.

The contractor shall be responsible for the bonding to the main earthing system of all electrical equipment supplied under this contract. The metal sheath and armour, if any, of all cables shall be connected to the main earthing system via a copper conductor.

Unless otherwise approved, the metallic sheath and/or armouring of single-core power cables laid in trefoil formation shall be bonded together and efficiently earthed where the trefoil breaks at each end of the run, and elsewhere as instructed by the Employer. The sectional area and contact of the bond shall be sufficient to carry normal currents and also the maximum fault current without undue heating of the bond.

All metal parts other than those forming part of an electrical circuit shall be connected in an approved manner to separate copper earth bars running along the bottom of boards and desks.

The dimensions of these earth bars shall be not less than 70 mm2 for control boards and desks and 150 mm^2 for switchboards. The Contractor shall submit detailed calculation for the sizing of the earth bars for approval by the Employer prior to ordering.

The metal cases of all instruments, relays and the like shall be connected to the copper earth bars by conductors of not less than 2.5 mm2 or by other approved means.

Earthing connections shall not depend on welded or bolted joints between the enclosures of panels or cubicles. Copper earth bars shall be provided in every case.

The use of electronic equipment and in particular solid-state controllers and programmable controllers, demands that special attention be paid to the cabling requirements and supplies to the equipment.

The recommendations of the suppliers of the equipment must be rigidly adhered to. In general, the considerations relate to the following areas:

- Earth faults on the power system must not result in excessive voltages on the electronic equipment.
- System disturbances (switching surges etc.) must be isolated from the electronic equipment.
- Signal cables shall be routed and screened to avoid induced signal noise, and the screens connected at the control panel end only, to avoid current loops.
- The use of galvanic or optical isolation may be necessary to avoid 'noise'.
- The circuit or 'electronic' earth shall be brought separately to the nearest main earthing point (substations typically) and shall not be connected to the equipment enclosures earth or the protective earth conductor for the equipment.

Tests shall be carried out on site to confirm that, when it is isolated from the existing earth system the resistance of the earth grid to the general mass of earth, is no greater than 1 Ohm.

Tests shall also be carried out on site to confirm that the overall interconnected grid resistance to the general mass of earth shall not exceed 0.5 ohms.

The Contractor shall measure and record the conductivity and continuity of all grid connectors prior to back filling.

12.0 GUARANTEED OPERATING CHARACTERISTICS OF PV FARM

12.1 General

The Employer has identified a number of guaranteed operating characteristic for the PV Farm. However, the Contractor shall provide any additional operating characteristic, deemed necessary, for the proper operation of the farm.

The Contractor shall also ensure compliance with all parts of IEC 61724 - Photovoltaic system performance Monitoring

12.2 Fault Ride through Requirements

The PV Farm shall remain connected to the distribution system for system voltage dips on any or all phases, where the system voltage of the CEB network remains above the blue line in the voltage duration profile of the Figure 11.1 below.

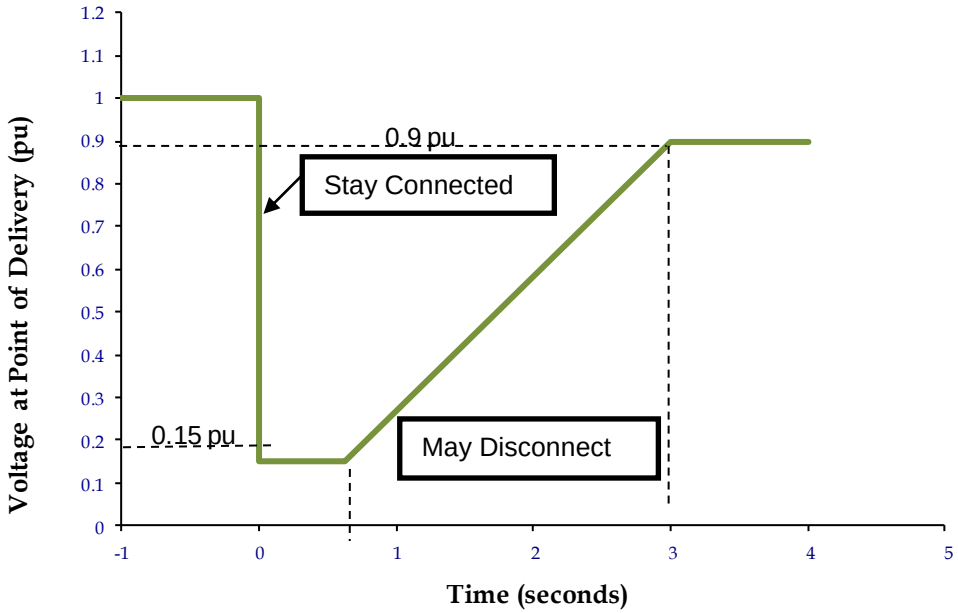

Figure 11.1: Fault Ride Through Requirement

In addition to remaining connected to the distribution System, the PV Farm shall have the technical capability to provide the following:

During the utility distribution system voltage dip, the PV Farm shall provide active power in proportion to retained voltage and maximise reactive current to the distribution system, within the technological and design limitations of the PV Farm facility and without exceeding its design limits. The maximisation of reactive current shall continue for at least 3 seconds or until the distribution System Voltage recovers to within the normal operational range of the distribution System whichever is the sooner.

Due to the dynamic nature of the distribution network, higher or lower fault clearance time and the LVRT voltage curve for the Solar Farm may be required. In this respect the above requirement shall be configurable from the Control Room by the Employer when required by the system operator.

The above LVRT curve shall be coordinated with the under-voltage protection settings to ensure grid support during fault conditions

12.3 Frequency Response

In case of frequency deviations in the CEB network, the PV Farm shall be designed to be capable to provide power-frequency response in order to contribute to the stabilization of the grid frequency. Under normal system frequency ranges, the PV Farm should operate with an active power output as set in Figure 11.2 below

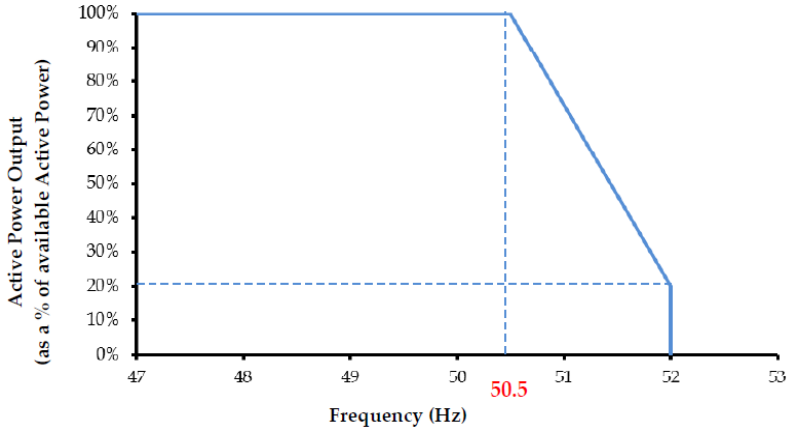

Figure 11.2: Frequency Response Requirements

The PV Farm shall have to reduce the power output about a system frequency above 50.5Hz. The power has to be reduced with a gradient of 40% per Hz of the instantaneously available power. The output power is only allowed to increase again as soon as the frequency is only 50.05Hz. Above 52Hz and below 47Hz the plant has to disconnect from the grid.

The above requirement shall be configurable from the Control Room by the Employer when required by the system operator.

12.4 Reactive Power Capability

The PV Farm shall be equipped with reactive power control functions capable of controlling the reactive power supplied by the PV Farm at the point of common coupling (PCC,) with CEB's network. The reactive power control functions shall be mutually exclusive, which means that only one of the two functions mentioned below can be activated at a time:

- Power Factor Control
- Reactive Power Control

- Voltage Control

The PV farm shall supply rated power (MW) for power factors ranging between 0.95 lagging and 0.95 leading, available from 20% of rated power measured.

All the threshold and mode of operation shall be configurable from the Control Room.

12.5 Power Quality

The PV Farm and equipment shall not cause excessive voltage excursions nor cause the voltage to drop below or rise above ±6%. The PV Farm and equipment shall not introduce excessive distortion to the sinusoidal voltage or current waves.

12.6 Limitation of voltage flicker induced by the MSDG

The installation shall not cause abnormal flicker beyond the limits defined in IEEE 519.

12.7 Harmonics

The total harmonic distortion will depend on the injected harmonic current and the system impedance seen from the PCC.

The PV Farm output should have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system. The PV system electrical output at the PCC should comply with IEEE Std. 519 and should be used to define the acceptable distortion levels for PV systems connected to a utility.

12.8 Voltage step change

The process of starting the PV Farm can sometimes cause step changes in voltage levels in the distribution network. These step changes are caused by inrush currents, which may occur when transformers or induction generators are energised from the network. Step voltage changes will also occur whenever a loaded generator is suddenly disconnected from the network due to faults or other occurrences.

Step voltage changes caused by the connection and disconnection of generating plants at the transmission level should not exceed +/- 3% for infrequent planned switching events or outages and +/-6% of the nominal voltage of 22 kV for unplanned outages such as faults.

12.9 Voltage Unbalance

The contribution to the level of unbalance of the voltage at the PCC of any installation with generation should be less than or equal to 1.3%.

12.10 Ramp Rate Limits

The ramp up in normal conditions, positive ramp rate only during start-up and negative ramp rate during shut down of the PV Farm shall be settable from the SCADA system. The following ramp rate is being proposed:

- 10 minute maximum ramp rate: PV installed capacity (MW) divided by 1.5; and
- 1 minute maximum ramp rate: PV installed capacity (MW) divided by 5.

The ramp rate averaged over one minute should not exceed 3 times the average ramp rate over 10 minutes.

The ramp rate settings provided in the SCADA, shall be approved by CEB prior to testing and commissioning of the system on the network.

12.11 Active Power Constraints / Curtailment

For system security reasons, it may be necessary for CEB System Control Center (SCC) to issue Curtail Instruction to the Solar Facility for the curtailment of active power output at the Point of Delivery.

The Solar Facility shall be capable of:

- Operating at a reduced level if a Curtail Instruction has been issued by the SCC.
- Commencing the reduction of the output power within 2 seconds on activation of curtailment functionality and complete the reduction not later than 1 minute. The duration within which to curtail shall be configurable from the SCADA System.

13.0 ELECTRICAL BUILDING SERVICES

13.1 LUMINARIES AND EXTERNAL LIGHTING

13.1.1 Lighting Design

The contractor shall design, provide and install a complete lighting installation system for building services, comprising 22kV Switchgear room, Solar Compact Station, Electrical Annex, Control room, Store, outdoor lighting and any other areas. The design and installation shall be as per the tender requirements and in compliance with MS 63 or equivalent.

Drawings including location, type and number of lighting to be used (schedule of lighting) shall be submitted for approval by the Employer prior to order. The Contractor shall review architectural drawings to verify that the types of lighting fixture he has chosen for the ceiling types, modules and suspension systems are appropriate.

For lighting system, CIBSE Lighting codes and European Standards shall be applicable.

The illumination levels for the various areas involved shall be as per Table 12.1 below. The design, together with accompanying calculations clearly showing the horizontal and/or vertical illuminance values corresponding to each feature being lit, shall be submitted to the Employer prior to order.

The Design shall consider the following to minimise energy consumption:

- Use of LED light fittings complete with LED Driver.
- Warranty shall be minimum of 5 years
- The balance between task and building illuminance.
- Availability of daylight lighting.
- Provision of switching controls to enable electric lighting to respond to daylight variations.
- Efficient exterior lighting.
- Required Illuminance Level at 750mm above floor level.
- All Luminaries shall be rated 230V±6% and 50Hz.

Minimum size of cable shall be 1.5 mm2 for lighting circuits. All lighting wiring shall be terminated directly at each end with other lighting terminal block. Connectors in between lighting shall not be used.

Fuses for systems at low voltage are not acceptable. Moulded case circuit breakers and where appropriate, miniature circuit breakers shall be used.

13.1.2 Luminaries

LED lighting is the preferred light source unless approved otherwise. The contractor shall provide the type of light fittings and include the supplier's details. Samples of all lighting shall be submitted to the Engineer for approval, prior to any order.

LED luminaires shall be provided complete with LED driver, LED controller, connectors and lamps. The metal work of all luminaires and equipment shall be effectively earthed to the installation.

Luminaires and lamp type shall be selected as appropriate for the area to be served. Luminaires shall be selected for ease of lamp changing and cleaning and have adequate mechanical and electrical features to ensure durability and resistance to Deterioration.

13.1.3 Fixtures

Areas within the building shall also be illuminated using LED light fittings. Luminaires shall be selected to provide the lighting level as set out in Table 13.1. External areas shall be illuminated using outdoor fittings suitable for the application with protective enclosures to IP66.

Fixtures shall also be factory assembled complete with all fittings, and delivered in factory fabricated containers or wrappings.

Metal parts shall be grounded. The rated voltage shall be 230Vac, 50Hz, single phase and neutral. The Contractor shall ensure safe handling and installation of the fixtures. The Contractor shall replace damaged units or components with new ones.

13.1.4 Luminaries Installation

Luminaires shall be installed complete with control gear, lamps, louvers or diffusers where specified, including any necessary fixings and steel supports. Where detailed specifically elsewhere the luminaire bodies to be installed in suspended ceilings.

Luminaires shall be cleaned prior to final handover, if necessary with an anti-static cleaning agent, to provide clean, dust free lighting.

13.1.5 Luminaire wiring

Wiring to all luminaires shall be non-hygroscopic and heat resisting.

Circuit wiring in lighting trunking shall be looped into flexible terminal blocks suitable for the temperature at which they will operate.

Circuit cables shall not be routed through bulkhead or other fittings where the cables would be liable to undue temperature rise. They shall terminate in a fixed base connector in a conduit box mounted behind or adjacent to the fitting. Final connection to each fitting shall be carried out with silicone rubber insulated cable.

Luminaire internal wiring shall be arranged such that it is not visible when lamps/reflectors/louvres are in place.

13.1.6 Exterior Installation and General Flood Lighting

The scope of work will also cover external electrification around the following facilities:

- External Doors of Compact Solar Station
- On both Compact Solar Substation, to cover the PV Farm.
- Under Canopy and adjacent to Doors for all External Doors of new switchgear room, control room and Store.
- All exterior lighting shall be automatically switched by predefined timers located out of range of artificial light sources. Manual override switches shall be provided on a Light control panel in gate post.

Luminaires shall be protected as follows:

- Index of protection minimum of IP65 unless otherwise specified in drawings or schedules.
- Luminaire bodies shall be manufactured in Aluminium, Epoxy Powder coated, moulded Polyester, any clips shall be Stainless steel or suitable plastic. Steel only to be used if galvanised.
- Diffusers shall be vandal resistant and UV stabilised.
- Shall not have the external case penetrated by the fixing screws of any internal component.

13.1.7 Emergency Lighting

Emergency lighting shall be provided in all rooms including the Compact Solar Station.

- Efficient lighting shall be ensured so as to allow technical team to cease operations safely and applied emergency procedures.
- Such lighting shall be adequate to enable technical team to visually check switchgear displays and control panel displays and enable personnel to carry out switching operations safely.
- Indicate clearly the escape routes.
- Ensure that fire alarm call points and firefighting equipment provided along the escape routes can be readily located.
- All other internal areas shall be provided with emergency lighting to illumination levels set in BS 5266.

- Emergency lighting shall be powered from self-contained battery sources and shall comply with BS 5266 and designed and manufactured as per BS EN 60598-2-22.
- The type, number and location of emergency luminaries shall be according to BS5266.
- Self-contained exit signs shall be provided at each exit from buildings. These shall be self-maintained emergency units. A minimum of 5 Lux illuminated exit signs shall be provided.
- Wiring systems of the emergency units shall be separate from the main supply.
- Self-Contained Emergency luminaries shall be carefully designed to achieve a 4 year battery design life.
- The Response time for high risk areas like Control Room and other switchgear room shall have a quick response time of 0.5s through the emergency duration.
- The minimum emergency duration (autonomy) shall be 3 hours.
- Emergency luminaires shall be connected direct to the mains supply. In the event of mains failure the unit shall automatically connect to the battery. On restoration of the permanent supply the unit shall revert to mains operation. Internal wiring and connections shall be carried out in silicone rubber covered cable. A green LED indicator shall be visible through the diffuser or louvre of the fitting to indicate when the batteries are on charge.

13.1.8 Lighting Control Switches

All lighting switches shall be fixed at a level of 1350mm above finished floor level and are general purpose rocker type switches. The number of gangs shall be as per approval of the Employer prior to ordering. They shall comply with BS 3676 and BSEN 60669. Switches for external use shall be weatherproof type to IP 66.

Lateral positions of the switched with respect to door jambs and corner walls shall be discussed and agreed with the Employer.

Switches shall be of the slow break, AC only pattern in which the successful operation of the switch does not wholly depend upon the action of a spring. The operating mechanism shall be insulated from all live parts. Switches shall have a minimum rating of 10amps and be suitable for inductive operation at their rated capacity.

All boxes used for fixing switches shall be supplied with an earth terminal or screw in the base of the box.

Any switch controlling equipment not visible from the switch point shall be engraved with a label identifying the final circuit it controls. Unless otherwise indicated, it shall be fitted with a 0.5 watt neon indicating lamp.

Switches shall preferably be rocker type mounted on an all insulated front plate. The front plate shall overlap the box on all sides.

The switches shall be mounted on boxes not less than 25mm deep of metal or white PVC depending on the type of construction. They shall have cable or conduit entries. PVC boxes shall have accessory fixing lugs or columns with brass fixing screw inserts.

Table 13.1: Lux Level

Item No	Area	Lighting Level Lux
1	HT Switchgear Rooms	300
2	Control/SCADA Rooms/AC panel rooms	500
3	Store	300
4	Transformer Cabin	300

13.2 LV AC Distribution Board

13.2.1 General

Distribution boards shall be provided as required for local 400/230 Vac distribution of lighting and small power (sockets) among others. The lighting and small power circuits may use a common distribution board.

They shall be fitted with the appropriate number and rating of circuit breakers, RCD's, distribution blocks, earth bars, neutral bars, etc. Electrical drawings shall be submitted for the LV Distribution board to the Engineer/Employer, prior to ordering of panel and equipment.

Each low voltage switchboard shall be of the single-busbar, built assembly type, in accordance with IEC 60439 and IEC 61439.

Install anti-condensation heaters inside MV cubicles and let them run continuously, i.e. without automatic or manual control.

13.2.2 Enclosures

The Main switchboard shall be of the freestanding floor mounted type and suitable for continuous operation in the environment specified. Provision shall be made for extension of the switchboard at both sides.

Other Distribution Board may be wall mounted.

They shall be unit or cubicle type construction from the same manufacturer as the switchgear.

They shall be protected to not less than IP31 for indoor use and shall be weatherproofed IP65 for exterior use.

The maximum height shall not exceed 2.30 m.

The switchgear shall be capable of withstanding the thermal, dielectric and dynamic stresses resulting from the maximum prospective short circuit currents without injury to personnel or damage to material.

The distribution switchboards shall include for the provision of the required number of circuit breakers plus at least two spare breaker and 30% spare space shall be provided.

The door or cover can be locked in the closed position. A lock and 3 keys shall be provided for each distribution board.

Distribution boards shall be capable of with-standing without injury the mechanical and electrical stresses set up by the prospective fault current for twice the period required to disconnect such fault on any circuit.

Distribution boards shall be provided with removable top and bottom un-drilled gland plates equipped with knock-outs for the outgoing cables corresponding to the circuit capacity of the distribution board and a suitable brass earthing stud.

Distribution boards shall be of sheet steel with either a galvanised or enamelled finish. The finish colour of all indoor distribution boards shall be chosen to match the adjacent switchboards.

The panels shall be fitted with flush mounted indicating lamps to indicate presence of voltage.

Neutral bars shall be drilled for an appropriate number of ways relative to the size of the board.

Enclosures shall be so designed and constructed as to protect all live parts to IP2X including live parts behind locked doors, removable panels, and particularly on the back of opening doors. So designed and constructed as to provide test facilities via 3mm holes in protection to IP2X as necessary for fault finding purposes.

Enclosures shall not be located such that it can be affected by the normal operation, maintenance or failure of mechanical services installation, including drainage.

The metal surface adjacent to any live part and all spaces between phases shall be protected by barriers or fireproof insulation material.

Engraved nameplates shall be fitted to the front cover of each distribution board giving the distribution panel board reference of each panel board. A circuit list shall be typed or printed 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 into a frame over the circuit list, the list and cover to be easily removable to permit circuit modifications. Allocation of circuits shall be in accordance with MS 63.

13.2.3 LV Distribution

The current rating of the busbars in each distribution board shall not be less than the sum of maximum current rating of all outgoing circuits. The neutral connection for each circuit is to be direct to the neutral busbar.

All distribution boards shall incorporate a main MCCB which shall isolate the incoming supply to the distribution board.

Socket outlets for working maintenance areas shall have Residual Current Circuit Breakers (RCCBs) comprising circuit breakers with integral ground leakage trip circuits.

The distribution boards shall be either single pole or triple pole and neutral types and shall be equipped with means to provide overcurrent protection to each circuit. This protection shall be a miniature circuit breaker, which shall be removable without exposing live connections.

Each sub distribution board supplied from main circuit breaker shall have an incoming Circuit breaker as part of the board. The rated current of the circuit breaker shall be not less than the total capacity of the distribution board unless otherwise specified.

Single Phase socket shall be incorporated within Main and Sub distribution board.

A sub distribution Board for the Workshop and Gate Post for Lighting and Sockets systems shall be provided.

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

All distribution boards and protective devices to be from a single manufacturer to ensure proper discrimination between the protective devices.

13.3 LV AC wiring

All LV wiring within polyethylene concealed conduits shall generally be PVC insulated single core copper conductor cables. Minimum size of cable shall be 1.5 mm2 for lighting circuits and 2.5 mm2 for socket circuits. Wiring cables shall be provided with copper conductors, with PVC insulation 450/750 volt grade, to BS 6004.

Cables sizes for other circuits shall be as specified on a one-line diagram of the relevant distribution or sub-distribution boards. Circuits' schematics from relevant distribution board shall be submitted for approval from the Employer/Engineer prior to implementation.

All cables supplied shall meet the approval of the Mauritius Standards Bureau and shall also comply with the relevant European Standards.

All LV Circuits for sockets and lighting shall be run inside appropriately sized PVC trunking. Necessary separation of voltages shall be ensured.

13.4 Plastic conduit and trunking

All plastic conduits shall be LSF to BS 4607 and BS EN 50086 as applicable. They shall be heavy gauge, high impact, smooth inside and outside, free from imperfection, of minimum diameter 20mm.They shall be protected from weather and all mechanical damage during installation or whilst stored at site. They shall be reamed to remove all sharp edges and burrs and shall be cleaned of all debris.

Conduits shall be to BS 4607 as applicable where they are to be cast in concrete. They shall be installed in accordance with the manufacturer's recommendations.

They shall have bends and sets formed with the aid of helical spring fitted internally, with the conduit warmed sufficiently for it to move without deformation of the bore, and with minimum wall thinning on the outside of the bend.

Plastic trunking shall be LSF in accordance with BS 4678 Part IV extruded unplasticised PVC compound. They shall be smooth inside and outside and free from imperfections. They shall be of the high impact resisting heavy gauge type fitted with drip proof lids.

13.5 Miniature Circuit Breakers and Moulded Case Circuit Breakers

- All moulded case circuit breakers (MCCBs) shall be of the high-speed fault limiting thermal/magnetic type to IEC 60947.
- MCBs may be used subject to the protection grading satisfactorily with other circuit breakers
- MCBs shall be equipped 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. Proper grading for the MCB shall be provided.

- Circuit breakers shall be of the high speed fault limiting, thermal/magnetic type with quick make and quick break trip free mechanisms which prevent the breaker being held in against overloads or faults.

13.6 Residual current devices (RCD’s) and RCBO

RCD’s and RCBO shall be provided to IEC 61008 and shall be rated as per the schematic or shall be 30 mA for all outlets. Unless otherwise specified, RCD/RCBO shall be of the one pole and Neutral or three pole and Neutral type. The Neutral shall open in event of tripping of the device.

13.7 Busbars and connections

Busbars shall be of constant cross section copper throughout. The copper conductors shall be tinned. Busbars shall be air insulated except where solid insulation is a design feature. They shall be connected to outgoing switches with solid copper connections. The connections to be as short and direct as possible.

Busbars shall be rigidly clamped and secured to prevent undue movement under fault conditions or displacement as a result of the installation of cabling and provided, where necessary, with insulated phase or circuit barriers. All clamping and supporting bolts, nuts and screws to be plated brass or steel.

Busbars shall be separate for individual supply systems. Two systems shall not occupy the same busbar chamber unless they are segregated and separated by earthed metal and warning notices fixed.

13.8 Power Sockets

Socket outlets shall be mounted 450 mm above finished floor level.

Socket outlets shall be to BS 1363. They shall be flush pattern where used with concealed systems, surface pattern elsewhere. They shall be switched type and shall be capable of switching full rated inductive or resistive load.

All sockets shall be supplied with 13 amp plugs complete with appropriate fuse to BS 1362 for equipment connected to socket outlets as specified in drawings.

Sockets shall be supplied with fixing flanges where fitted into plasterboard partitioning.

The position and quantity of general 13 A socket outlets in rooms shall be in accordance with MS 63.
Twin Sockets shall be installed as per the following locations:

Table 13.2: Number of Sockets

Item No	Area	Sockets
1	HT Switchgear Room	4
2	Control/SCADA Room	Minimum of 4
3	Stores	3
4	Solar Compact Station	2

Three phase and neutral, and single-phase and neutral industrial socket outlets shall be provided in the workshop. Socket outlets shall consist of the following:

- 400 V ac, 32 A, three phase and earth, semi flush mounted, corrosion-protected, self-closing cover.

- 230 V ac, 16 A, single phase, neutral and earth, corrosion-protected, self-closing cover.

MCCB or MCB shall be provided to protect the incoming circuit and feeder circuit to each socket outlet. Power supply cables shall be sized in accordance with the requirements of MS 63.

Industrial sockets shall be single phase and three phase types. The sockets shall be heavy-duty and at least IP44.

13.9 Testing

The whole of the equipment provided shall be subject to inspection and witnessing of tests by the Employer and/or Engineer. The procedure shall include the testing of all equipment in accordance with the IEE Wiring Regulations. The Contractor shall submit a programme of testing for the Engineer's approval.

13.10 Insulation Tests

Tests shall also be made on complete circuits for lighting, socket outlets, etc. between poles and to ground and shall include associated switches and distribution switch.

The procedure shall include for the rectification of faults or the renewal of any part of the installation which fails or breaks down a result of the insulation tests.

13.11 Continuity Tests

Ground continuity tests shall be made for each item of electrical equipment, lighting fittings, switch and socket outlets to the main grounding connections for the installation. This shall be the point where the main bonding conductor to the ground electrode system is connected to the main grounding terminal on the main switchboard.

13.12 Ground Loop Impedance Tests

Ground loop impedance tests shall be made for all socket outlets in the installation and shall show the complete ground loop impedance from the socket outlet. Records of these tests shall be handed over to the Engineer or Employer.

13.13 Phase Rotation Tests

The phase rotation at each three-phase socket outlet shall be checked and verified to be standard anticlockwise phase rotation and sequence L1, L2, L3.

13.14 RCD Operation Tests

Residual current devices test at a test current of 50%, 100% and 500% of the rated tripping current.

13.15 Testing Equipment

Shall be correctly calibrated and certified for the limits of accuracy necessary and identified by serial number on each test sheet. If an instrument used is considered suspect it shall be tested by an authorised standard testing laboratory. All equipment shall meet the requirements of BS EN 61557 Equipment for testing up to 1000V.a.c to ensure safety of the operator. Calibration certificate which has been issued maximum one month prior to the testing sessions shall be produced to the Engineer before any test is carried out.

Tests instruments shall be provided with insulated and shrouded probe.

13.16 AIR CONDITIONING UNIT

13.16.1 General Type and Capacity

The Contractor shall supply, install, split type air conditioning units using DC inverter technology in HT Switchgear room and Control Room

The Contractor shall carry out all relevant civil works and shall calculate the proper sizing in terms of BTU rating for each room.

1. Air Conditioner Characteristics:
   - Indoor Unit:

   - Wall mounted/ cassette type
   - Horizontal / vertical air flow
   - Low noise level at high speed
     (Less than 52 dBA at 1 m from the unit)
   - Automatic air deflection
   - Variable fan speed and temperature control
   - Wireless remote control with LCD temperature display and holder

   - Presence sensors

   - One touch air filter (down to 0.01 micron)
   - Slim, compact and of elegant design
   - LED display

   - Outdoor Unit:

   - shall be suitable for tropical climates
   - shall be weatherproof, cyclone proof
   - Rotary type compressor

The location of the indoor units shall be agreed with the Employer prior to installation.

The guarantee for the air conditioners complete system shall be at least 3 years.

All split type air conditioners shall be equipped with remote controls by means of which the air conditioners may be switched on and off, the temperature and fan speed may be controlled and from which one may read the room/office temperature via an LCD display.

Any supports, mounting brackets etc. (to be hot dipped galvanized) shall be supplied and installed by the successful bidder.

The outdoor units shall be fixed on galvanised brackets on the wall of the building or on concrete base on the roof of the building. Rubber mounting pads shall be provided in between to limit vibration in the equipment.

All piping (refrigerant and drain) shall be enclosed within white pvc trunking of suitable dimensions indoors and outdoors. Note that the cover of same shall be securely fixed as not to be blown away by cyclonic gusts. Moreover, all joints shall be suitably sealed by means of silicon rubber.

Air Conditioners shall be supplied by 230V ac from the LV Distribution Board. The AC units shall be controlled by double pole switches with red LED indicator that are properly rated. The successful bidder shall undertake the electrical installation from the air conditioners to the switches. The electrical installation from the switches to the air conditioners shall have to be concealed in conduits of sufficient size. The cable from indoor units to outdoor units shall pass through trunking/conduits of appropriate size.

The bidder shall test and commission the Air conditioning units in presence of the Employer.
Redundant air conditioning system shall be implemented in the control room.
The air conditioning system shall not cause accumulation of dust.

14.0 FIRE PROTECTION SYSTEM

14.1 Fire Alarm Panel

The system shall employ a microprocessor-based addressable Fire Alarm Control Panel (FAP).

Manual call points, heat detectors and smoke detectors shall be sited in accordance with the minimum distances specified in BS 5839 as a minimum standard of installation but shall be increased in number as necessary to provide a full and effective system.

Areas to be covered shall be as follows:

- 22kV MV Switchgear (substation) Room
- Control Room
- Store
- Transformer Cabin
- AC Room
- Any other area where protection is required.

The Following documents shall be submitted to the Engineer/ Employer prior to any order:

- Submit manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment.
- Include standard or typical riser and wiring diagrams, and operation and maintenance instructions for inclusion in maintenance manuals.
- Provide drawings showing equipment/device locations and connecting wiring of entire fire alarm system.
- Building plan showing zoning and location of fire controller, detectors, call points, sounder and other devices.

The components of the system shall be manufactured by companies regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristic required, and whose products have been in satisfactory use in similar service for not less than 5 years.

The system shall be installed by a company with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project. The company shall have a factory authorised service organisation and spare parts stock.

Comply with BS EN 54 and the applicable requirements of NEC standards pertaining to fire alarm systems.

The Fire alarm system shall be installed, completed, tested and commissioned in presence of the Engineer/ Employer.

The main control panel shall be placed in the control room and repeater panel if any shall be installed in easily accessible location and shall be approved by Engineer/Employer.

The control panel shall be complete with power supply unit, batteries, integral charger, all control, indicators and any other equipment. The control panel shall be designed and manufactured according to NFPA and European Standards.

The panel shall be surface mounted and the front fascia shall have a lockable door.

The Features of the Fire alarm panel shall be as follows:

- A well labelled front fascia with instructions how to use the panel and testing instructions to be affixed next to the panel.
- When a fire alarm is manually or automatically raised, the zone shall be identified on the panel with annunciators. A back lit lamp annunciator shall be provided, with two lamps per
- All zone devices shall be monitored for open and short circuit faults and indicated by appropriate zone fault indicator and internal buzzer.
- Internal sounder: Pulses during mains failure or if battery disconnected and sounds continuously for other faults.
- The internal battery system shall be provided for at least 24 hours standby operation. It shall further be capable of withstanding full alarm load for at least 5 minutes.
- Provide control panel for operation on 230 volts AC supply with integral battery stand by power source.
- All Fire Alarm signals shall be sent to the SCADA system in the local control room and shall be recorded.

14.2 Conduit and Wiring

PVC concealed conduit/trunking and wiring shall be carried out using fire retardant low smoke material. Cables shall be shielded type. Call points shall have a minimum conductor size of 1.5mm2 and Sounders wiring shall have a minimum of 2.5mm2. Joints in the cables shall be avoided. If joints are necessary, this should be done in junction boxes which are clearly labelled FIRE ALARM. Conduit systems used for fire alarm wiring shall not be utilized for any other service.

The contractor may be requested to provide certificates for ensuring that the cables and conduits used are fire resistant and suitable for use in fire alarm installations.

Connections shall be made at terminal strips in cabinets or at equipment terminals.

Run cables in recessed conduit for drops to units in areas requiring flush installations.

14.3 Fire Alarm Detectors

The Fire Alarm detectors shall have the following features:

All detectors shall be of the analogue addressable type.
These shall be identifiable by a light emitting diode provided on the detector casing.
The detector bases shall be suitable for interchanging with same of different types of detectors.
Detectors shall provide separate fire and fault signals.
Addressable Ionization Smoke Detectors shall be used and shall connect with two wires to the fire alarm control panel.
The detectors shall use the dual-chamber ionization principal to measure products of combustion.
The detectors shall capable of operation on either 2-wire or 4-wire loops. A 57 °C fixed temperature heat detector shall be provided in each base.
Heat Detectors shall be automatic addressable detectors.
The detectors shall provide an alarm and power LED. The LED shall flash under normal conditions. The LED is placed into steady illumination by the control panel, indicating that an alarm condition has been detected.
The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a switch, or may be activated remotely on command from the control panel.

14.4 Manual Call Points

Manual Call points shall have the following features:

- Shall have LED indication
- Shall be surface mounting type with red enclosure and break glass operation
- Shall be to IP 54 with weather resistant gasket
- A 200 x 200 mm sign, “FIRE ALARM BOX”, shall be provided over each fire alarm pull station and mounted perpendicular to the wall, red with 60 mm high white letters.

14.5 Sounders

Both outdoor and indoor sounders shall be installed, so that it is clearly audible all over the PV farm site and inside building. The manufacturer’s standard fire alarm sounders shall be provided, surface mounted and with double projection.

The specifications are as follows:

- The electronic sounders shall operate on 230V AC.
- Shall be vandal proof.
- The outdoor electronic sounders shall be to IP66
- Shall have a sound level of at least 5 dB above the normal noise in the premises.

14.6 Alarm Lights

Alarm lights with flashing red lenses shall be provided, plain or lettered white “FIRE”.

Field Quality Control
Submit shop drawings for function and operation only, pre-approved by authority having local jurisdiction.
Submit copy of test results in duplicate signed by Employer’s Representative to Engineer, Employer, Employer’s Insurance Company and local Fire Protection Authority.

14.7 FIRE PROTECTION

In addition to the existing Fire alarm system requirements defined, the switchgear room shall have complete and failsafe thermal management systems. All associated equipment, shall have complete and failsafe fire detection/ system. The fire protection system shall comply to NFPA standards. The Fire Protection system design and associated alarms shall take into account that the plant will be unattended. All Fire Alarm signals shall be sent to the SCADA system in the local control room and shall be recorded.

14.8 MOBILE AND PORTABLE FIRE EXTINGUISHERS

The general arrangement and choice of fire extinguishing equipment shall be such that it is capable of delivering a concentrated and swift fire extinguishing attached at any given point in all areas containing high-grade or otherwise valuable apparatus or equipment.

Within the building portable fire extinguishers are to be arranged in all stairwells and corridors circulation in an adequate number and in such a manner so that circulation is not affected. In addition they shall be installed at easily visible and easily accessible places.
Additional portable powder type extinguishers shall be installed in areas where there are special fire hazards.

All extinguishers in indoor and outdoor plant areas shall be housed in suitable surface mounted stainless steel cabinets with full double strength glass door, continuous hinge and pull handle.

In addition, all the buildings and plant areas shall be provided with a mobile dry powder fire extinguisher, located at a central spot. In the event of a more extensive outbreak of fire, it must be possible to concentrate the discharge as required for optimal effect. The mobile gas fire extinguishing equipment must, in accordance with its purpose and function, be suitable for unrestricted grading to fire class E (electrical installations) in conformity with NFPA Standards.

The minimum equipment shall be provided is as follows:

- Steel cylinders, each containing 30 kg of dry powder
- Nozzle with the necessary high-pressure hose
- Hand cart(s) with cylinder mountings and wheels fitted with solid rubber types

The mobile and portable fire-extinguishing equipment must, as a result of their immediate readiness for operation, give the operation personnel the possibility of tackling any fire which has broken out immediately and effectively.

In additional to and together with the other fire detection and protection equipment the mobile and portable fire-extinguishing equipment shall be fitted with spring-loaded, interchangeable safety valves, in accordance with the acknowledged international standards.

15.0 Weather Monitoring Stations

The Contractor shall provide two (2) monitoring stations which would record meteorological data to evaluate PV farm performance. Stations shall be located at strategic points within the array field (ideally one on each wing of the PV farm). The monitoring station shall be capable of collecting the data points at every one-minute interval. The station shall be equipped with a sufficiently high data storage capability thus ensuring the data are recorded for at least one year. Moreover, the Contractor shall also have to make provision for a UPS system such that even in the absence of AC power for two (2) days, the data are still recorded.

Additionally, the recorded data shall be displayed on real-time on the SCADA screen available in the Control Room. The following three (3) main parameters should mandatorily be monitored by each station:

- Solar irradiance (W/m2) – pyranometers (measuring, global, direct and diffused solar irradiations) with a measurement tolerance within ± 2 % shall be installed
- Ambient air temperature - accuracy better than ± 1 % shall be installed next to the irradiation sensors
- Relative humidity - accuracy better than ± 1 % shall be installed next to the irradiation sensors

The monitoring systems shall be supplied complete with its available software/hardware, user manuals and appropriate technical support. Measurement of key technical parameters shall be done at one-minute intervals.

<u>Software for Daily Production Forecast</u>

The Contractor shall provide a software for daily production forecast at least 30 (thirty) Business Days prior to the start of the Commissioning Tests

The daily forecast software shall have the capability to produce an hourly production forecast in kW for the following day of the Solar Facility

In addition to the One Day Ahead Production Forecast, the software (at every interval of 30 minutes) shall provide a revised forecast for the next half hour from the Solar Facility. These forecasting shall be transmitted to CEB via an electronic interface. The Contractor shall liaise with the Employer and CEB to provide for an appropriate method to transmit this information at design stage.

The actual output (metered output) of the Solar Facility shall be within a tolerance of +/-10% of the revised forecast at any instant and this shall be tested during the reliability testing period.

16.0 INSPECTION, TESTING, COMMISSIONING AND TAKING OVER

16.1 General

The whole of the Works supplied under the Contract shall be subject to inspection and testing by the Engineer should he so require, during manufacture, erection and after completion. The inspection and tests shall include, but not be limited by, the requirements of this Section. Prior to inspection and testing the plant and equipment shall undergo pre-service cleaning and protection as specified in this Section.

The Contractor shall engage Lloyds Register of Shipping as third party inspection and certification or any other equivalent classification society of all major plant items including PV panels and inverters.

Testing and Commissioning of the PV Farm shall be carried out in accordance with IEC **62446-1-** Photovoltaic (PV) systems - Requirements for testing, documentation, and maintenance – Part 1: Grid-connected systems – Documentation, commissioning tests and inspection

16.2 Attendance of Factory Acceptance Tests by Employer Representatives

Four (4) technical members of staff representing the Employer shall attend Factory Acceptance Tests (FAT) for the PV modules and inverter prior to shipment. The Employer shall bear the costs for transportation of the Employer's personnel from Mauritius and accommodation and subsistence for the above FAT tests.

16.3 Comprehensive Protection Study

The Contractor shall submit a comprehensive protection study, at least 30 (thirty) Business Days prior to the start of the Pre-Commissioning Tests including but not limited to:

(i) All protection calculations complete with graphs (the graphs shall demonstrate discrimination for faults at both the MV and LV level taking into consideration the fault level at each level of the Solar Facility); and

(ii) Grading of the interconnection protection with CEB substation protection

CEB shall provide the relevant network information to the Contractor for the purpose of the protection study.

16.4 Planning for Pre-Commissioning and Commissioning Phase

The Contractor shall submit appropriate, pre-commissioning and commissioning procedures and plans as per applicable standard for the Solar PV farm to the Employer approval at least 3 (three) months prior to the Completion Date. A detail schedule/plan for all tests to be performed shall be submitted to the Employer, for approval, at least 14 working days before the start of the testing phase for the Solar farm. The Contractor shall notify the Employer of any change in the schedule at least 5 working days ahead of the previously planned testing date.

The Contractor shall perform the, pre-commissioning and commissioning phases of the solar PV farms as per relevant standards norms. The Contractor shall keep written records of test results and protection settings for submission to the Employer.

16.5 Requirements of the Pre-Commissioning and Commissioning Phase for PV Farm

A number of typical tests, among others, for the PV farm have been identified by the Employer. However, it is the responsibility of the Contractor to ensure that all required tests are performed to ensure compliance of the Solar farm with the requirements of this Contract, relevant standards and requirements of concerned utilities & regulatory authorities at the time of commissioning, unless agreed otherwise with the Employer. This compliance shall include, but is not limited to, compliance with relevant grid codes and technical requirements for HT metering, including subsequent amendments within the Contract period. In case of any discrepancy between the requirements of this Contract and the requirements of concerned utilities & regulatory authorities, the Contractor shall inform the Employer, for his approval, of the discrepancy and of the proposed technical specifications for the Solar farm.

The pre-commissioning tests identified are as follows:

- Earthing continuity of array frame to earth and connection to main earthing terminal
- Polarity of each module string
- PV string Open-Circuit Voltage (Voc) Test;
- PV Short Circuit current (Isc) Test;
- PV array insulation Test;
- Operational Test PV string current;
- Functional Test;
- Protection Relay Testing;
- Insulation resistance Testing; and
- Performance verifications;

The Commissioning tests identified are as follows:

- Demonstration of satisfactory operation of power and weather measurement equipment;
- Function tests of the relay protection and verification of settings;
- Demonstration of satisfactory operation of control equipment;
- Demonstration of satisfactory operation of 22 kV the internal electrical network of the Solar Facility;
- Demonstration of satisfactory operation of the Step-Up Transformer and its associated protections
- 24 hours voltage test on the cables;
- Reactive Power Capability; and
- Any other test found deemed necessary by the Commissioning Engineer (refer to Section 14.6 below).
- All tests performed shall be approved by the Employer. Further details on the tests to be performed are outlined in the Sections hereunder.

16.6 Pre-Commissioning and Commissioning Procedures

The commissioning process includes visual inspections as well as measurements and soft-ware parameter settings.

Most of the commissioning procedures will be made before the system is energized. These Pre-Commissioning tests shall be performed in the presence of the Employer and its Engineer.

The Employer reserves the rights to request the Contractor to perform additional tests which the Employer may find necessary to ensure conformity to grid connection.

- The Contractor shall provide a reputable Registered Professional Electrical Engineer from the Council of Registered Professional Engineers of Mauritius, having at least two years' experience in the commissioning of utility scale PV Farm. The role and functions of the Commissioning Engineer shall be:
- Review of the drawings and documents for the project
- Review, inspection and monitoring of construction works
- Propose and finalise appropriate testing procedures as per IEC norms with the Contractor at least 3 (three) months prior the Scheduled Commissioning Date of the Solar Facility
- Conducting all tests with respect to the Solar Facility, including independent tests on completion of Construction Works
- Issuing the Completion Certificate and certification of the Solar Irradiation Measurement System;

- Determining, as required under the Agreement, the period or any extension thereof, for performing any duty or obligation;
- Approve the design of the Solar Facility, the Contractor's Distribution Assets and the Contractor's Interconnection Facilities
- Certify that the civil and structural designs of the Solar Facility, Distribution Assets and Interconnection Facilities are cyclone resistant;
- Review and approve the Operating Procedures Manual
- Undertaking all other duties and functions as required by the Contractor to ensure conformity to grid connection.

16.7 Mounting Structure

The following inspections and tests on the mounting system shall be made:

- Installation done according to the Employer approved drawings;
- Torque test on rack screw connections;
- Load tests (pull out force ≥ design load) conducted at random posts;
- Damages to galvanization layers;
- For tracking system (if applicable), necessary lubrication system is provided
- Measurement of earthing and equipotential bonding resistance of the PV array racks to the inverter main earthing terminal.

In case of any defects or failure of the above tests, the Contractor shall carry out remedial actions in order to make the system good. The Employer and Engineer shall verify and approve the remedial works.

The following documents shall be provided and included in the plant documentation:

- Static design calculations of the mounting structure.
- For the tracker(if applicable): specific bearing loadings, bearing safety factors & lubrication details
- Measurement protocols of equipotential bonding and earthing.
- As built drawings.
- Load test report (pull out test on IPE piles).
- Torque test report

16.8 PV Modules

The following inspections and checks shall be made on the PV Modules:

- Visual failures (e.g. cell breakage, delamination, hot-spots, glass breakage)
- Dirt and foreign objects on the module surface shall be removed
- Modules are mounted according to the installation requirements.

In the event, the modules are found to be defective or damaged, the Contractor shall replace same.

The following documents shall be provided and included in the plant documentation:

- A report of observed visual inspections
- Module flash list of the installed modules. (Module performance data at STC conditions, provided by the manufacturer).
- Module datasheet, IEC Certificates

16.9 DC string cable installation

All PV modules are equipped with touch-safe plug connectors and appropriate number of PV modules are electrically connected in series to form a PV string and all string cables are properly installed:

1. Check that string cable are properly attached on cable trays fixed to the mounting structures;
2. Check if the string cables are protected from direct UV irradiation exposure
3. Check the sharp edges of support structures does not cause any abrasion
4. Check if minimum bending radius of string cables is respected
5. Connectors are tied up to avoid water intrusion at the cable glands and pulling forces on the connectors avoided.
6. Cable pipes ends (if applicable) are properly sealed

A report with all observations shall be provided for each string.

16.10 DC Combiner Boxes

Visual checks and measurements must be made at the combiner boxes to ensure correct installation of the PV strings and the combiner boxes.

Visual inspection shall include mainly the following aspects:

- Mechanical installation according to the manufacturer guidelines
- DC cable connections correct
- Torque of DC main cable connections correct
- Fuse links/Miniature circuit breaker are suitable for the PV module protection
- Load break switch for each string & Main Cable circuit breaker
- Surge protection devices
- Door sealing not damaged

- Cable glands are tight
- Communication cable connection is correct
- Warning sign that warns against disconnection under load
- Proper cable markings
- Cable terminations are according to specifications
- Positioning of the combiner boxes for ease of access

1. Individual String cable insulation in accordance with IEC 62446 (measurement made with 1000V DC test voltage and the insulation resistance must exceed 1MΩ);
2. Polarity check & Open circuit voltage for each string (at stable irradiance conditions the values should vary within ±5%.
3. Short circuit current for each string (at stable irradiance conditions the values should vary within ±5%.
4. Operational current (after start-up of the inverters) to check the availability of individual strings. As string monitoring is included in the combiner box, the monitoring results can be used to check the operational string currents. (At stable irradiance conditions, the values should maximal vary within ±5%).
5. Earth resistance of each combiner box

A commissioning report with all inspection and measurement results shall be provided for each combiner box.

16.11 DC Distribution Board

DC Distribution panel shall receive the DC output from the array field. If the Contractor's design incorporates a DC distribution board, it shall be inspected and tested in accordance with Section 5.3.4 above.

A commissioning report with all inspection and measurement results shall be provided for each Dc Distribution panel.

16.12 DC main cables

The following inspections and checks shall be made on the DC main cable installations:

Visual inspection of the cable routing;

1. Cable termination with correct screw torque and correct crimping of cable lugs
2. Correct cable polarity installation
3. Cable insulation measurement to earth (≥ 1 MΩ)
4. Cable pipes (If any) shall be sealed
5. Cable clamping underneath the combiner box and inside the inverter is correct

A report with all observations shall be provided for each DC main cable.

16.13 LV & MV cables

- The LV/MV cable installation shall be checked for:
- Cable types and dimensions are as per approved design
- Correct and thorough installation of the terminals
- As an minimum requirement an insulation test shall be carried out to avoid cable damages after cable laying

A commissioning report with all inspection and measurement results shall be provided for LV/MV cables.

16.14 AC Inverter Paralleling Switchboard

AC Distribution Panel Board

If the Contractor's design incorporates an ACDB, it shall be inspected and tested as follows:

1. Visual inspection to include mainly the following aspects:
2. installation is as per approved design drawings;
3. AC cable connections with appropriate lugs and cable markings;
4. Torque of main cables connections correct;
5. Circuit breakers and load break switches are appropriately installed as per approved design drawings
6. Surge protection devices are properly installed;
7. Check that door sealing are not damaged
8. Cable glands are tightly fixed
9. Communication cable connection is correct
10. Warning sign indicating prevention against disconnection under load
11. Cable insulation in accordance with IEC 62446 (measurement made with 1000V DC test voltage and the insulation resistance must exceed 1MΩ)
12. Earth resistance of each ACDB

A commissioning report with all inspection and measurement results shall be provided for each ACDB.

16.15 Inverters

The plant inverters shall be commissioned on site by the Contractor or manufacturer's representative and will confirm that the inverter can be operated locally as per specification

and that automatic operations such as wake-up and sleep routines, power tracking, remote monitoring and fault detection responses, amongst others operate as per specifications.

Visual inspection and measurement of the inverter set-up to check that:

1. There is sufficient free space around the unit.
2. The ambient operating conditions are met.
3. The unit is properly fastened to the floor and/or wall.
4. The cooling air is able to flow freely and cooling air volume is sufficient
5. The inverter is grounded properly.
6. The AC line voltage matches the nominal output voltage of the inverter.
7. The AC transformer is suitable for use with the inverter(s).
8. The insulation of the assembly must exceed 1MΩ
9. The AC power system is grounded as per approved design.
10. The AC power cable connections of the 3 phases and their tightening torques are correct
11. The DC power cable connections of the positive and negative terminals and their tightening torques are correct
12. The power cables are routed separately from communication and supervisory cables.
13. The auxiliary power supply cable connections and their tightening torques
14. The auxiliary voltage level
15. The external control connections to the inverter (including emergency stop, fieldbus etc.) are properly wired;
16. All shrouds and covers are in place.
17. Operating software are up-to date.

16.16 Step Up transformers

The step-up transformer(s) shall be checked:

1. Transformer installation carried out according to the manufacturer installation manual.
2. Cables terminations and connections to transformer are correct
3. Insulation resistance test at the transformer windings.
4. Check of the voltage and phase sequence at the LV side.
5. A functional test of the temperature controller shall be carried out.
6. Earthing (both tank and neutral) of transformers correct
7. Dielectric strength of transformer oil

A commissioning report with all inspection and measurement results shall be provided for the transformer(s).

16.17 MV switchgears

The MV switchgear shall be checked:

1. Installation is made according to manufacturer installation manual.
2. Check of the transformer and outgoing interconnection feeder protection
3. Commissioning of the LV auxiliary supply and UPS system
4. Commissioning of the MV switchgear room air conditioning
5. An insulation resistance test shall be made.
6. A hi-pot / pressure test shall be made.
7. The contact resistance (Ductor test) of the busbar connection shall be measured.
8. Commissioning of protection relays and control settings
9. Commissioning of PT's & CT's
10. Test and demonstration of the satisfactory operation of the power measurement equipment
11. Commissioning of meter installation
12. Commissioning of the SCADA system integration
13. SCADA functional test of commands, status signals and alarms
14. Operational and safety equipment and single line diagram board present
15. Correct labelling of all equipment
16. Commissioning of the Station Controller and HMI
17. A commissioning report with all inspection and measurement results shall be provided for the MV switchgears.

16.18 Weather Monitoring Station

The check and commissioning procedure includes:

1. Check of the irradiance sensor installation (mechanical fixing, azimuth orientation and inclination)
2. Check of the module/ambient temperature sensors installation
3. Check of the installation for relative humidity sensor
4. Check of the auxiliary supply voltage and UPS installations
5. Check of the communication and SCADA system integration

A commissioning report with all inspection and measurement results shall be provided for the weather monitoring sensors.

The sensors' calibrations certificates have to be submitted to the Employer.

16.19 SCADA & Communication Systems

The commissioning procedure of the SCADA system shall include:

1. The monitoring server is correctly installed and operational
2. Control room air conditioning functional
3. On site, all inputs, outputs and functions shall be successfully tested by simulation prior to connection of field devices
4. Internal and external communication are operational
5. A commissioning report with all inspection and measurement results shall be provided for the SCADA and communication system.

16.20 Test for Compliance with Guaranteed Operating Characteristics

The following tests shall be conducted to ensure the Solar PV farm is in compliance with the guaranteed operating characteristics detailed in Section 11.

1. Fault Ride Through
2. Frequency response
3. Reactive Power Capability
4. Power Quality
5. Ramp rate limits

16.21 Start Up & Reliability Testing

Following the successful completion of the pre-commissioning and commissioning tests, the Contractor shall notify its readiness to start the reliability testing of the solar PV Farm in accordance with a program as determined by the Employer. The duration of the reliability test shall be for a period of 30 days without the plant encountering any kind of failure or interruption.

The plant will be operated by the station staff under the supervision of the Contractor's engineers during the Reliability Test period, but the Contractor shall be allowed to make any minor adjustment which may be necessary.

Should any failure or interruption occur in any portion of the plant due to or arising from faulty design, materials, workmanship or to omissions or to incorrect erection sufficient to prevent safe and full commercial use of the plant, the Reliability Test shall be considered void, and the reliability test period of 30 days shall re-commence after the Contractor has remedied the cause of defect.

During the test period, an outage of up to 24 hours (the cumulated hours of outages shall not exceed 24 hours) for the PV farm shall be allowed to cover for minor faults. If this period is exceeded, the Reliability Test shall be restarted. Stops due to faults of the Employer’s staff, unacceptable grid variations or lack of electrical load, or other responsibilities of the Employer are not considered as stops in this context. Failure of major component shall result in restart of the test.

All adjustments made by the Contractor shall be recorded by him in a manner to be specified by the Engineer.

16.22 Taking Over Certificate

The Taking Over Certificate shall be issued after successful completion of the site inclusive of the reliability test period. The issuing of any such certificate, however, shall not relieve the Contractor of any of his responsibilities in respect of any of the remedies provided under this Contract in the event of the guarantees failing to be proved.

Section 5. Forms of Bid and Appendices to Bid

Notes on Preparing Forms of Bid and Appendix to Bid

The Bidder shall complete and submit the Form of Bid and Appendix to Bid, all in accordance with the requirements of the bidding documents.

A. Bid Submission Forms

Form of Technical Proposal
Appendix Form of Technical Proposal
Form of Financial Proposal
Appendix to Form of Financial Proposal

B. Bidder Qualification Forms

ELI-1: Bidder Information Sheet
ELI-2: JV/Association/Sub-contractor Information Sheet
CON-1: Historical Contract Non-Performance
FIN-1: Financial Situation
FIN-2: Average Annual Construction Turnover
FIN-3: Financial Resources
FIN-4: Current Contract Commitments/Works in Progress
EXP-1: General Design Experience
EXP-2: General Design and Construction Experience
EXP-3: Similar Design Experience
EXP-4: Similar Construction and Design Experience
EXP-5: Specific Design Experience in Key Activities
EXP-6: Specific Construction and Design Experience in Key Activities
EXP-7: Environmental (E) Management Experience
EXP-8: Health and Safety (H&S) Management Experience

C. Technical Offer Forms

Tech 1: Technical Proposal
Tech 2: Construction Equipment
Tech 2: CVs of Key Personnel

A. Bid Submission Forms

Form for Technical Proposal

Name of Contract: _____
To: _____ *(Insert name and address of Employer)*
_____

Gentlemen:

(1) We have examined the Conditions of Contract, Employer's Requirements & Specifications, Schedules, Addenda Nos _____ and the matters set out in the Appendix hereto. We have understood and checked these documents and have not found any errors in them. We accordingly offer to design, execute and complete the said Works and remedy any defects fit for purpose in conformity with these documents and the enclosed Proposal.

(2) We hereby confirm that the bid complies with:

(a) the Bid validity in accordance with ITB 18 and,
(b) a Bid Security in the amount of Rupees 600,000 in accordance with ITB 19.

(3) 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.

(4) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible under the laws of Mauritius or official regulations or by an act of compliance with a decision of the United Nations Security Council.

(5) We have taken steps to ensure that no person acting for us or on our behalf will engage in any type of fraud and corruption as per the principles described hereunder, during the bidding process and contract execution:

i. We shall not, directly or through any other person or firm, offer, promise or give to any of the Public Body's employees involved in the bidding process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

ii. We shall not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelisation in the bidding process.

iii. We shall not use falsified documents, erroneous data or deliberately not disclose requested facts to obtain a benefit in a procurement proceeding.

We understand that transgression of the above is a serious offence and appropriate actions will be taken against such bidders.

(6) We hereby declare that we are bound by the terms and conditions as well as the price proposal submitted in the separate envelope.

We are, Gentlemen
Yours faithfully

Signature _____ in the capacity of _____ duly authorized to sign bids for and

on behalf of _____

Address
_____

Appendix to Technical Proposal

Bidders should fill in the remaining blank spaces in the Appendix. Bidders are required to sign each page of the Appendix to Bid.

	Conditions of Contract Sub-Clause	
Parties and Persons	1.1.2.2	Employer is: ***Central Electricity Board***.
	1.1.2.4	Engineer is: ***Central Electricity Board*** .
Dates, Tests, Periods and Completion	1.1.3.3	Execution of works after handing over of site to contractor shall be within **Twelve (12) months** from the Commencement Date.
Defects Notification Period	1.1.3.7	Defects Notification Period shall be: **24 Months** ***starting from the final Taking-Over***
Warranty		Warranty on the system and equipment shall be as specified in the Employer`s Requirements.
Works and Goods	1.1.5.6	Sections of the Works shall be as follows: N.A
Communications	1.3(a)	Agreed systems of electronic transmission are: E-Mail or Fax
	1.3(b)	Address of the Employer is: **Ag. General Manager** **Central Electricity Board** **Rue du Savoir** **Cybercity, Ebene** **Republic of Mauritius**
	1.3(b)	Address of the Engineer is: **Central Electricity Board** **Rue du Savoir** **Cybercity, Ebene** **Republic of Mauritius**
	1.3(b)	Address of the Contractor is: ***[insert information]***.
Law and Language	1.4	Law in force governing the Contract is Laws of Mauritius
	1.4	Ruling language of the Contract is: English.
	1.4	Language for communication is: English.
Right of Access to the Site	2.1	Employer shall give the contractor access to site 7 days after commencement date and after submission of all approved program, methodology statements as per Employer Requirements, approvals, bonds and securities, evidence of insurances and other required

		document at that stage.
Engineer's Duties and Authority	3.1(ii)	Engineer's authority to instruct a Variation is limited to: twenty-five percent (25 %) of the Contract Price.
	3.1(iii)	Engineer's authority to approve a proposal for Variation submitted by the Contractor is limited to: twenty-five percent (25 %) of the Contract Price.
Performance Security	4.2	Performance Security will be in a form acceptable to Employer in the amount of: Ten percent (10 %) of the Accepted Contract Amount, payable in the currencies and proportions of the Accepted Contract Amount.
General Design Obligations	5.1	Contractor's obligation to notify the Employer of errors, faults or defects in the Employer's Requirements is: prior to the base date.
Working Hours	6.5	Normal working hours are as per local labour and Mauritian laws
Delay Damages	8.7	Delay damages shall be in the amount of: Two percent (2 %) of the final Contract Price per week or part, in the currencies and proportions in which the Contract Price is payable.
	8.7	Maximum amount of delay damages shall be: Ten percent (10 %) of the final Contract Price.
Plant and Materials intended for the Works	14.5(b)(i) 14.5(c)(i)	Interim payments for approved plant and materials delivered on site only is payable
Delayed Payment	14.8	Refer to Conditions of Particular Application.
General Requirements for Insurances	18.1	(a) Insurance for design Evidence of insurance and policies to be submitted before the commencement date (b) Other insurance Evidence of insurance to be submitted before the date of possession of site by contractor and policies within 14 days after possession.
Insurance for Works and Contractor's Equipment	18.2(d)	Deductibles per occurrence shall be nil or the minimum possible and at the sole expense of the contractor.
Insurance against Injury to Persons and Damage to Property	18.3	Limit of occurrence shall not be less than MUR 300 Million per occurrence, or a series of occurrences arising out of any one event. This cover shall be extended to the Employer and its representatives
Insurance for Design	18.5	Limit for insurance shall not be less than: MUR 60 M.
Appointment of the Dispute Adjudication	20.2	DAB shall comprise of the number of members as defined by the rules of the arbitration center of

Board		Mauritius.
Failure to Agree Dispute Adjudication Board	20.3	Appointing entity shall be the Registrar of the LCIA-MIAC Arbitration Center of Mauritius.
Arbitration	20.6(a)(i)	Procedure to settle disputes in respect of DAB's decisions: by international arbitration conducted pursuant to the Arbitration Rules of the LCIA – Mauritius International Arbitration Center (LCIA-MIAC) Rules. a) Appointed arbitration institution: LCIA/MIAC Arbitration Center, Mauritius b) Seat of Arbitration: Mauritius

Initials of signatory of Bid _____

Form for Price Proposal

Name of Contract: _____
To: _____ *(Insert name and address of Employer)*
_____
Gentlemen:

(a) We have examined the Conditions of Contract, Employer's Requirements & Specifications, Schedules, Addenda Nos. _____ and the matters set out in the Appendix hereto. We have understood and checked these documents and have not found any errors in them. We accordingly offer to design, execute and complete the said Works and remedy any defects, fit for purpose in conformity with these documents and the enclosed Proposal, for the fixed lump sum of :

Site	**PV Farm**	***(insert currency)***	***(insert currency)***	***(insert currency)***	***(insert Currency)***
Grenade	1MWac				
Grand Total excluding VAT					

or other such sums as may be determined in accordance with the terms and conditions of the Contract. The above amounts are in accordance with the Price Schedules herewith and are made part of this bid.

(b) We agree to abide by this Bid until **08 April 2020** and it shall remain binding upon us and maybe accepted at any time before that date. We acknowledge that the Appendix forms part of our Bid.

(c) We have no conflict of interest in accordance with ITB Sub-Clause 4.3;

(d) If our bid is accepted, we will provide the specified performance security, preference security (if applicable), commence the Works as soon as reasonably possible after receiving the Employer's Representative's notice to commence, and complete the Works in accordance with the above-named documents within the time stated in the Appendix to Technical Proposal.

(a) Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and Address of Agent	Amount and Currency	Purpose of Commission or Gratuity
_____	_____	_____
_____	_____	_____
_____	_____	_____

(if none, state “none”).

(f) We have taken steps to ensure that no person acting for us or on our behalf will engage in any type of fraud and corruption as per the principles described hereunder, during the bidding process and contract execution:

i. We shall not, directly or through any other person or firm, offer, promise or give to any of the Public Body’s employees involved in the bidding process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not

legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

ii. We shall not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelisation in the bidding process.

iii We shall not use falsified documents, erroneous data or deliberately not disclose requested facts to obtain a benefit in a procurement proceeding.

We understand that transgression of the above is a serious offence and appropriate actions will be taken against such bidders.

(d) We understand that:-

a. you are not bound to accept the lowest or any bid you may receive; and

b. this bid, together with your written acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.

(e) We understand that

We are, Gentlemen
Yours faithfully

Signature _____ in the capacity of _____ duly authorized to sign bids for and on behalf of _____

Address
_____
_____

Date _____

Appendix to Price Proposal

Bidders should fill in the remaining blank spaces in the Appendix. Bidders are required to sign each page of the Appendix to Bid.

	Conditions of Contract Sub-Clause	
Parties and Persons	1.1.2.2	Employer is: ***Central Electricity Board***.
	1.1.2.4	Engineer is: ***Central Electricity Board .***
Communications	1.3(a)	Agreed systems of electronic transmission are: E-mail or Fax
	1.3(b)	Address of the Employer is: **Ag. General Manager** **Central Electricity Board** **Rue Du Savoir** **Cybercity, Ebene** **Republic of Mauritius**
	1.3(b)	Address of the Engineer is: **Central Electricity Board** **Rue Du Savoir** **Cybercity, Ebene** **Republic of Mauritius**
	1.3(b)	Address of the Contractor is: ***[insert information]*** .
Law and Language	1.4	Law in force governing the Contract is Laws of Mauritius
	1.4	Ruling language of the Contract is: English.
	1.4	Language for communication is: English.
Provisional Sums	13.5(b)(ii)	Not Applicable
Adjustments for Changes in Cost	13.8	Not Applicable
Advance Payment	14.2	Total advance payment shall be: Ten percent (10 %) of the Accepted Contract Amount.[19] Number and timing of installments of the advance payment shall be one after issue of Advance Payment Guarantee issued by a Commercial Bank operating in

[19] The advance payment be limited to fifteen (15) percent of the Accepted Contract Amount for works procurements; however, if circumstances warrant, higher percentages may be considered.

		Mauritius. Currency in which the advance payment shall be paid is: in proportion of the currencies of the Accepted Contract Amount.
Application for Interim Payment Certificates	14.3(c)	Not Applicable
	14.3(c)	Limit of retention money shall be: Ten percent (10 %) of the Contract Price.
Issue of Interim Payment Certificates	14.6	Part payment shall be effected during execution of the works based on Section VIII Schedule of Payment. From each payment, as per Section IX Schedule of Payment, excluding the Advance Payment, to the Contractor, the Employer will retain 10% to construe the Retention Money. The Employer will deduct the difference in the final payment to constitute the 10% Retention Money.
Payment	14.7	Payment shall be made as per Section IX Schedule Of Payment within 30 days from receipt of invoices and supporting document.
Delayed Payment	14.8	Financing charges shall be at the prevailing rate of interest at the legal rate for each occurrences in which payments are made.
Payment of Retention Money	14.9	The Payment of Retention Money shall be within 60 days after the Defect Liability Period. The Employer may consider releasing the Retention Money after the Taking Over Certificate against a bank guarantee provided by a commercial bank operating in Mauritius.
Currencies of Payment	14.15	Currencies of payment shall be in the currencies of the bid

B. Bidder Qualification Forms

Form ELI-1: Bidder Information Sheet

Each Bidder must fill in this form.

Bidder's legal name	
In case of JV or other association, legal name of each member	
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 numbers, fax numbers, e-mail address)	

Attached are copies of the following original documents.

❑ 1. In case of single entity, articles of incorporation or constitution of the legal entity named above,

❑ 2. Authorization to represent the firm or JV named in above, in accordance with ITB 6.2

❑ 3. In case of JV agreement, letter of intent to form JV or JV agreement, in accordance with ITB 6.2.

Form ELI-2: JV/Association/Sub-Contractor Information Sheet

Each member of a JV/Association making up a Bidder and each known subcontractor must fill in this form.

JV /Association/Subcontractor Information	
Bidder's legal name	
JV Member's or Subcontractor's legal name	
JV Member's or Subcontractor's country of constitution	
JV Member's or Subcontractor's year of constitution	
JV Member's or Subcontractor's legal address in country of constitution	
JV Member's or Subcontractor's authorized representative information **(name, address, telephone numbers, fax numbers, e-mail address)**	
Attached are copies of the following original documents. ❑ 1. Articles of incorporation or constitution of the legal entity named above,. ❑ 2. Authorization to represent the firm named above, in accordance with ITB 6.1 and 6.2.	

Form CON–1
Historical Contract Non-Performance

The following table shall be filled in for the Bidder and for each member of a joint venture or other association that is a party to the Bidder.

Bidder's Legal Name: **[insert full name**]

Date: **[insert day, month, year]**

Bidder's Party's Legal Name: **[insert full name]**

Page **[insert page number]** of **[insert total number]** pages

Non-Performing Contracts in accordance with Section 1A, Evaluation and Qualification Criteria Requirements			
☐ Contract non-performance did not occur during the ten years prior to the deadline for Bid submission in accordance with **Section 1A, Evaluation and Qualification Criteria Requirements))**, Sub-Factor 2.2.1. **OR** ☐ Contract(s) not performed during the ten years prior to the deadline for Bid submission in accordance with **Section 1A, Evaluation and Qualification Criteria Requirements**, Sub-Factor 2.2.1.			
Year	**Non performed portion of contract**	**Contract Identification**	**Total Contract Amount (current value, MUR/USD equivalent)**
[insert year]	**[insert amount and percentage]**	Contract identification: **[indicate complete contract name, number, and any other identification]** Name of institution: **[insert full name]** Address of institution: **[insert street/city/country]** Reason(s) for non-performance: **[indicate main reason(s)]**	**[insert amount]**

Form CON–2
Litigation history

The following table shall be filled in for the Bidder and for each member of a joint venture or other association that is a party to the Bidder.

Bidder's Legal Name: **[insert full name**]

Date: **[insert day, month, year]**

Bidder's Party's Legal Name: **[insert full name]**

Page **[insert page number]** of **[insert total number]** pages

Current and Past Proceedings, Litigation, Arbitration, Actions, Claims, Investigations and Disputes in accordance with Section III, Evaluation and Qualification Criteria Requirements (each member of a JV/association making up a Bidder must complete this table)		
Provide information on current or past proceedings, litigation, arbitration, actions, claims, investigations or disputes over the last ten (10) years as shown in the form below in accordance with Sub-Factor 2.2.3 of Section 1 A, Evaluation and Qualification Criteria Requirements. The Bidder, or a related company or entity, is currently, or within the past ten (10) years has been, involved in any proceeding, litigation, arbitration, action, claim, investigation or dispute the process or outcome of which the Employer could reasonably interpret may impact or have the potential to impact the financial condition of the Bidder in a manner that may adversely affect the Bidder's ability to satisfy any of its obligations under the Contract: ☐ No **OR** ☐ Yes **If Yes, Describe:**		
Year:	**Matter in Dispute:**	**Value of Award (Actual or Potential) Against Consultant in US$ Equivalent:**

FIN-1: Financial Situation

Each Bidder or member of a JV/Association making up a Bidder must fill in this form.

Financial Data for Previous 5 Years [US$ Equivalent]				
Year 1:	**Year 2:**	**Year 3:**	**Year 4:**	**Year 5:**

Information from Balance Sheet

Total Assets					
Total Liabilities					
Net Worth					
Current Assets					
Current Liabilities					

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 5 years, as indicated above, complying with the following conditions.

- All such documents reflect the financial situation of the Bidder or member of a JV or other association, and not sister or parent companies.
- Historic financial statements must be audited by a certified accountant.
- Historic financial statements must be complete, including all notes to the financial statements.
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Financial Ratios

Current Ratio					
Debt Ration					

*Bidders to fill this table. The Employer will verify during the review process**.**

FIN-1. Financial Situation (continued)

Key Financial Information extracted from Audited Accounts/Financial Statements

Financial data in the currency reported in the Audited Accounts/Financial Statements	**Historical Information**			**Remarks by BEC**
	Previous years	**Last year**	**Current year**	
Statement of Financial Position (Information from Balance Sheet)				
A. Current Assets				
B. Current Liabilities				
Working capital ratio or current ratio(A/B)				
Quick ratio or Acid Test ratio (Current Asset net of stock / B)				
C. Total Assets				
D. Total Liabilities				
Net Worth(C-D)				
Cash in hand and at Bank				
Bank Overdrafts				
Other Liquid Assets				
Information from Income statement				
Key Profitability Indicators in the currency reported in the Audited Accounts/Financial Statements	**Previous years**	**Last year**	**Current year**	
Turnover				
Profit /(Loss)Before Tax				
Taxation				
Net Profit /(Loss) After Tax				
(Net profit After tax)x 100 (Turnover)				
Certified by Bidder that information are true extract from Audited Accounts/Financial Statements Name: Signature: Capacity: Date:				

FIN-2: Average Annual Turnover

Each Bidder or member of a JV/Association making up a Bidder must fill in these forms.

Annual Turnover Data within any 5 Years over Last 10 Years			
Year	**Amount Currency**	**Exchange Rate**	**MUR/USD**
Average Annual Construction Turnover			

The information supplied should be the annual construction turnover of the Bidder or each member of a JV/Association making up a Bidder in terms of the amounts billed to clients for each year for work in progress or completed, converted to USD at the rate of exchange at the end of the period reported.

Annual Turnover Data with any 5 Years over the Last 10 Years			
Year	**Amount Currency**	**Exchange Rate**	**MUR/USD Equivalent**
Average Annual Design Turnover			

The information supplied should be the annual design turnover of the Bidder or each member of a JV/Association making up a Bidder in terms of the amounts billed to clients for each year for work in progress or completed, converted to MUR/USD at the rate of exchange at the end of the period reported.

FIN-3: Financial Resources

Each Bidder or member of a JV/Association making up a Bidder must fill in this form, specifying proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject Contract or contracts as indicated in **Section 1A, Evaluation and Qualification Criteria Requirements**.

No.	Source of Financing	Amount MUR/USD
1		
2		
3		
4		

FIN-4: Current Contract Commitments / Works in Progress

Each Bidder and each member of a JV/Association making up a Bidder 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.

Name of Contract	Employer, contact address/tel/fax	Value of outstanding work (current MUR/USD)	Estimated completion date	Average monthly invoicing over last six months (MUR or USD /month)

Form EXP-1: General Design Experience

Each Bidder or member of a JV/Association making up a Bidder must fill in this form.

General Design and Construction Experience				
Starting Month Year	**Ending Month Year**	**Years**	**Contract Identification and Name** **Name and Address of Employer** **Brief description of the Designs Executed by the Bidder/Member of a JV/Association making up the Bidder**	**Role of Bidder/Member of a JV/Association making up the Bidder**

Form EXP-2: General Design and Construction Experience

Each Bidder or member of a JV/Association making up a Bidder must fill in this form.

General Construction Experience				
Starting Month Year	**Ending Month Year**	**Years**	**Contract Identification and Name Name and Address of Employer Brief Description of the Works Executed by the Bidder/Member of a JV/Association making up the Bidder**	**Role of Bidder/Member of a JV/Association making up the Bidder**

Form EXP-3: Specific Design Experience

Fill in one (1) form per contract.

Contract of Similar Size and Nature			
Contract No . . . . . of	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Designer**	❑ **Subcontractor**
Total Contract Amount	**MUR**		
If a member of a joint venture or other consortium making up the Bidder or a subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax Number** **E-mail**			
Description of the similarity in accordance with Sub-Factor 2.4.2 (a) of Section 1A			

Form EXP-4: Specific Design and Construction Experience

Fill in 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	**MUR**		
If member of a JV or other association, or a subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax Number** **E-mail**			
Description of the similarity in accordance with Sub-Factor 2.4.2 (a) of Section 1A			

Form EXP-5: Specific Design Experience in Key Activities

Fill in one (1) form per contract.

Contract with Specific Key Activities			
Contract No . . . . . of	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount	**MUR**		
If member of a JV or other association, or a 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 Sub-Factor 2.4.2 (b) of Section1A			

Form EXP-6: Specific Design and Construction Experience in Key Activities

Fill in one (1) form per contract.

Contract with Specific Key Activities			
Contract No . . . . . of	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount	**MUR**		
If member of a JV or other association, or a 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 Sub-Factor 2.4.2 (b) of Section 1A			

Form EXP-7: Environmental Management Experience

Each Bidder or member of a JV/Association making up a Bidder must fill in this form.

Starting Month Year	Ending Month Year	Contract Identification and Name Name and Address of Employer Brief Description of the Works Executed by the Bidder, the Types of E Impacts Encountered, and Mitigation Measures Implemented	Role of Bidder (i.e. primary contractor or sub-contractor responsible for E issues)

Form EXP-8: Health and Safety (H&S) Management Experience

Each Bidder or member of a JV/Association making up a Bidder must fill in this form.

Starting Month Year	Ending Month Year	Contract Identification and Name Name and Address of Employer Brief Description of the Works Executed by the Bidder and H&S Measures Implemented	Role of Bidder (i.e. primary contractor or sub-contractor responsible for H&S issues)

C. Technical Offer Forms

Form TECH-1: Technical Proposal

[Public bodies may amend the content of items (a) to (e) and/or insert additional items, if required, to reflect specific aspects of their respective project]

Note to Bidders. Bidders are required to submit their Technical Proposal in accordance to Section 1V – Employer's Requirements. The items mentioned hereunder are a recap for bidders to submit their documents in sufficient details to demonstrate their understanding of the project and challenges they may face to meet the required design, manufacture of works and the measures envisaged to mitigate their negative impact.

(a) Proposed layout of all elements of the works comprising of drawings and specifications; that will form the design proposal; Discussions on how the Bidder proposes to incorporate environmental considerations including preventive and management of negative impacts, Health and Safety concerns into the design and during the execution of works,

(b) Method statement for execution of the works which shall demonstrate the adequacy of the Bid to meet the Employer's Requirements and for achieving the Employer's objective with regards to performance under the Employer's Requirements and to complete the whole of the Works in accordance with the stated requirements in the Conditions of Contract; Statement demonstrating Bidder's appreciation and recognition of current conditions within the limits of site, present installation and any arrangements needed and included in the Bid to minimize disruption during the execution of the Works; Description of the risks to safety within the limits of site and surrounding areas created by the execution of the Works and the measures included in the Bid to mitigate risk to all personnel involved with the Works and including the general public. Description of arrangements which the Bidder proposes to adopt and has included in the Bid for testing and testing upon completion, as may be called for in the Employer's Requirements; and arrangements which the Bidder proposes to adopt and has included in the Bid for handover, including completion of as-built drawings, and any additional matters.

(c) A Program which shall form the basis of the Contractor's detailed time program and which includes a schedule of key activities for execution of the Works, including estimated start and finish dates for individual activities, identifying those activities for which timing may be critical within the Time for Completion; the program shall include but not necessarily limited to details of:

i. the proposed schedule to complete mobilization in preparation for carrying out the Works,

ii. proposed timeline for carrying out the Works within the Time for Completion, in the form of a bar chart showing notably the critical path,

iii. the resource requirements (personnel, equipment and materials) to complete the Works within the Time for Completion, the proposed timeline for the testing, commissioning and handing over of the completed Works,

iv. the proposed schedule for preparation of the work program, site-specific Contractor's Environmental Management Plan, site-specific Health and Safety Management Plan, Quality Assurance Plan, and design , including designs reviews and approval by the Engineer..

(d) The Cash Flow Projection indicating quarterly projected expenditure throughout the duration of the Contract, both the percent of the Accepted Contract Amount and the cumulative

percentage of the Accepted Contract Amount by quarter. It shall also address the following, taking into consideration payment of the advance payment, minimum payments, and the retention:

- The periodic payments by milestones for the completion of the mobilization. and
- The periodic payments based on measurement for the construction of the Works

(e) A Project Management Organization showing lines of communications as well as communications plan managing communications with key stakeholders; Plans for subcontracting any parts of the Works and the services to be carried out by specialized Subcontractors; Completed Subcontractor Information Sheets for all such identified specialized Subcontractors; Quality management system, describing the basis and operation of the proposed quality management system, including testing, reporting and dealing with nonconformities, corrective actions, and feedback.

(f) Bidders should provide details of their experience as Prime contractor and those of their sub-contractors for past similar projects that demonstrate their capacity to design, supply, install, test and commissioning PV Farms similar to those required by the Employer for a proper assessment of the marking criteria at item 4 of Section 1A – Evaluation and Qualification Criteria.

Form TECH-2: Construction Equipment

Refer to Schedule of Major Items of Constructional Plant in Section 7 Schedules

Form TECH-3: CVs of Key Personnel

Name of Bidder

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 over the last 5/8 years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company / Project / Position / Relevant technical and management experience

Section 6. Sample Forms

Section 6. Sample Forms

Notes on Sample Forms

Bidders shall complete and provide the Bid Security (where applicable) all in accordance with the requirements of the bidding documents.

Bidders should NOT complete the Form of Agreement at this time. Only the successful Bidder will be required to complete the Form. The Form of Agreement, when it is finalized at time of contract award, should incorporate any corrections or modifications to the accepted bid resulting from arithmetic corrections, acceptable deviations (time for completion, technical deviations, commercial deviations, etc.), spare parts or quantity variations in accordance with the requirements of the bidding documents.

The Form of Performance Security and Form of Advance Payment Security should NOT be completed by the bidders at the time of bid preparation. Only the successful Bidder will be required to provide these securities in accordance with the forms indicated herein or in another form acceptable to the Employer. Where Advance Payment Security is not required, the form(s) should not be included in the bidding documents.

Table of Contents

Form of Bid Security (Bank Guarantee)

.....Bank's Name and Address of issuing Branch or Office

.....

Beneficiary:.....*Name and Address of Public Body…….....*

Date: .....

BID GUARANTEE 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.....*[IFB number] ….*..... ("the IFB").

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

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 figures]…..... .(.....amount in words.....)* 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 modified or withdrawn its Bid after the deadline for submission of its bid during the period of bid validity specified by the Bidder in the Form of Bid; or
(b) has refused to accept a correction of an error appearing on the face of the Bid; or
(c) having been notified of the acceptance of its Bid by the Public Body during the period of bid validity, (i) fails or refuses to sign the contract Form, if required, or (ii) fails or refuses to furnish the performance security, in accordance with the Instructions to Bidders.

This guarantee shall expire: (a) if the Bidder is the successful bidder, upon our receipt of copies of the contract 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) thirty 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 .....*[Public Body to insert date]*.....

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758. (Applicable to overseas bidders only).

.....*[Bank's seal and authorized signature(s)]* .....

Form of Contract Agreement

This Agreement made this _____ day of _____ 20 _____ between _____ _____ of _____ (hereinafter called “the Employer") of the one part and _____ of _____ (hereinafter called "the Contractor") of the other part

Whereas the Employer desires that the Works known as _____ should be designed and executed by the Contractor, and has accepted a Bid by the Contractor for the design, execution and completion of such Works and the remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement:

(a) The Letter of Acceptance dated _____
(b) The Employer's Requirements
(c) The Addenda nos. _____
(d) The Bid dated _____
(e) The Conditions of Contract (Parts I and II)
(f) The completed Schedules, and
(g) The Contractor's Proposal.

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to design, execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor, in consideration of the design, execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written in accordance with their respective laws.

Authorized signature of Employer

SEAL
(if any)

in the presence of:

Name _____
Signature _____
Address _____

Authorized signature of Contractor

SEAL
(if any)

in the presence of:

Name _____
Signature _____
Address _____

Form of Performance Security
(Bank Guarantee)

To: _____ *[name of Employer]*
_____ *[name of Employer]*

WHEREAS_____ *[name and address of Contractor]* (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ *[name of Contract and brief description of Works]* (hereinafter called "the Contract");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with its obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible *to* you, on behalf of the Contractor, up to a total of _____ *[amount of Guarantee]*[20] _____ *[in words],* such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ *[amount of Guarantee]* as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

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

This guarantee shall be valid until the date of issue of the Performance Certificate.

Signature and Seal of the Guarantor _____
Name of Bank _____
Address _____
Date _____

[20] An amount is to be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract, and denominated either in the currency(ies) of the Contract or in a freely convertible currency acceptable to the Employer.

Form of Advance Payment Security
(Bank Guarantee)

To: _____ *[name of Employer]*
_____ *[address of Employer]*
_____ *[name of Contract]*

Gentlemen:

In accordance with the provisions of the Conditions of Contract, Sub-Clause 13.2 *("*Advance Payment") of the above-mentioned Contract, _____ *[name and Address of Contractor]* (hereinafter called "the Contractor") shall deposit with _____ *[name of Employer]* a bank guarantee to guarantee its proper and faithful performance under the said Clause of the Contract in an amount of _____ *[amount of Guarantee]*[21] _____ *[in words].*

We, the _____ *[bank],* as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____ *[name of Employer]* on its first demand without whatsoever right of objection on our part and without its first claim to the Contractor, in the amount not exceeding _____ *[amount of Guarantee]*[1] _____ [in words].

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

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____ *[name of Employer]* receives full repayment of the same amount from the Contractor.

Yours truly, _____
Signature and Seal: _____
Name of Bank/Financial Institution: _____
Address: _____
Date: _____

[21] An amount is to be inserted by the Bank or financial institution representing the amount of the Advance Payment, and 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.

Section 7. Schedules

Section 7. Schedules

Notes on Schedules

The Schedules are intended to provide the Employer with essential supplementary information in an organized format. 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 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.

In Option A, Single Stage Bidding Procedure, all Schedules are to be completed and submitted with the bid.

In Option B, Two Envelope Bidding Procedure, the schedules are to be completed and submitted as part of the Technical Proposal and Price Proposal in accordance with the Instructions to Bidders (Option B) Clause 13, Documents Comprising the Bid.

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

- ***I. Design, Drawings and Documentation***
- ***II. Plant and Equipment (including Mandatory Spare parts) supplied from outside the Employer's Country***
- ***III. Plant and Equipment (including Mandatory Spare parts) supplied from within the Employer's Country***
- ***IV. Civil Works, Installation and Other Services***
- ***V. Summary***
- ***VI. Grand Summary***
- ***VII. Training of CEB Personnel***
- ***VIII. Recommended Spare Parts***

2. The quantities shown in these Schedules are estimates only.

3. The Schedules do not generally give a full description of the plant and equipment 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 documents 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 include for the full scope as aforesaid including overheads and profit.

4. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Bidders in the bidding documents.

***Notes on Schedules** (continued)*

For each item, bidder 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 the Employer's Requirements, Drawings or elsewhere in the bidding documents.

5. Items left blank will be deemed to have been included in other items. The TOTAL for each Schedule and TOTAL of the Grand Summary shall be deemed to be the total price for executing the facilities and sections thereof in complete accordance with the Contract.

6. These Schedules are intended primarily to provide information for bid evaluation but not intended to be used for the evaluation of work done for the purpose of interim payment. They may, however, be used as a reference for the adjustment of the Schedule of Payment should the need arise.

7. These Schedules can be used as a basis to value variations of work done under the Provisional Sum.

SCHEDULES OF PRICES
(DDP delivery at site of work excluding VAT for Schedules I to IV)

I. Design, Drawings and Documentation

Item	Description	Quantity	Rate		Total Price	
			Foreign Currency[a]	Local Currency[a] [b]	Foreign[a]	Local[a]
	TOTAL (To Summary)					

a Currencies shall be in accordance with Clause 16 of the Instructions to Bidders.
b Include duties and taxes.

II. Plant & Equipment, including mandatory spare parts, supplied from outside the Employer's Country

Item	Description	Country of Origin	Foreign Currency[a]		Local Currency		Total Price	
			FOB	CIF	Taxes & Duties	Local Transport	Foreign[a]	Local[a]
	TOTAL (To Summary)							

a Currencies shall be in accordance with Clause 17 of the Instructions to Bidders.

III. Plant & Equipment, including mandatory spare parts, from within the Employer's Country

Item	Description	Quantity	DDP (Delivery at site)	Total MUR
	Total to Summary			

a Currencies shall be in accordance with Clause 17 of the Instructions to Bidders.

IV. Civil Works, Installations and other Services

Item	Description	Quantity	Rate (excluding VAT)		Total Price (excluding VAT)	
			Foreign Currency[a]	Local Currency[a b]	Foreign[a]	Local[a]
	TOTAL (To Summary)					

a Currencies shall be in accordance with Clause 17 of the Instructions to Bidders.
b Include duties and taxes.

V. SUMMARY

Item	Description	Total Price (excluding VAT)	
		Foreign ( )[a]	Local ( )[a]
1	Schedule I. Design, Drawings and Documentation		
2	Schedule II Plant and Equipment, including Mandatory spare parts, supplied from abroad		
3	Schedule III. Plant and Equipment, including Mandatory spare parts, from within the Employer's Country		
4	Schedule IV Civil Works, installation and other services		
	TOTAL **(To Grand Summary)**		

a Specify currency.

VI. GRAND SUMMARY

Site	PV Farm	Prices carried forward from Summary Sheet for each site			
		(insert currency)	***(insert currency)***	***(insert currency)***	***(insert currency)***
Grenade	1MW ac				
Grand Total (carried forward to Price Bid Form					

VII. Training of CEB Personnel (OPTIONAL)

(Not to be added to Bid Price)

Item	Description	Quantity	Unit Price		Total Price	
			Foreign Training	Local Training	Foreign ( )[a]	Local ( )[a]
	TOTAL					

a Specify currency.

VIII. Recommended Spare Parts

(Not to be added to Bid Price)

Item	Description	Quantity	Unit Price		Total Price	
			From Abroad ( )[a]	Local Ex-Factory ( )[a]	Foreign ( )[a]	Local ( )[a]
	TOTAL					

a Specify currency.

IX. SCHEDULE OF PAYMENT

Payment made on completion of Stage

Stage (insert brief description		Percent	Amount	Cumulative%
1st	Advance payment	10%		10 %
2nd	Project Implementation Review	5%		15 %
3rd	Completion of Civil Works	10%		25%
4th	Delivery of all Equipment at Grenade	50%		75%
5th	Installation Completed on Site	5%		80 %
6th	Testing and Commissioning	15%		95 %
7th	Submission of O&M manual, documents and all documents and manuals requested in the Technical Specification	5%		**100 %**
Total		**100 %**		

Note: From each payment, excluding the Advance Payment, to the Contractor, the Employer will retain 10% to construe the Retention Money. The Employer will deduct the difference in the final payment to constitute the 10% Retention Money.

X. SCHEDULE OF MAJOR ITEMS OF CONSTRUCTIONAL PLANT

Description (Type, Model, Make)	No. of Each	Year of Manufacture	New or Used	Owned (O) Or Leased (L)	Value (insert currency)	Est. Power Rating	Capacity t or m^3

The Employer should select appropriate major headings to suit the nature of the Works. The bidder shall enter in this Schedule all major items of Construction Plant which he proposes to bring on site, both owned and leased (rented), and shall indicate the proposed port of entry.

XI. SCHEDULE OF KEY PERSONNEL

	Name		Summary of qualifications
	(i) Nominee (ii) Alternate		Experience and Present Occupation
Headquarters			
Partner/Director			
Other Key Staff			
(give designation)			
Site Office			
Site Superintendent			
Deputy Superintendent			
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 Work, together with their qualifications, positions held and their nationalities.

XII. SCHEDULE OF SUBCONTRACTORS

Element of Work	Approximate Value	Name and Address of Subcontractor	Statement of Similar Works Previously Executed

The bidder shall enter in this Schedule a list of the Sections and appropriate value of the work for which he proposes to use subcontractors, together with the names and addresses of the proposed subcontractors. The bidder shall also enter a statement of similar works previously executed by the proposed subcontractors, including description, location and value of work, year completed, and name and address of the Employer/Employer's Representative. Notwithstanding such information, the bidder, if awarded the Contract, shall remain entirely and solely responsible for the satisfactory completion of the Works.

XIII. SCHEDULE OF GUARANTEED PARTICULARS

Bidders have to fill in all the data in these Forms:

Sheet 1- PV Modules

PV Module Technical Specifications at STC	
Manufacturer	…….
Module Model	…….
Type	Mono-crystalline
Manufacturer	……..
Nominal power (PMPP)	……Wp
Power tolerance	-…../+….%
Voltage at PMAX (VMPP)	……. V
Current at PMAX (IMPP)	……. A
Open circuit voltage (VOP)	……V
Short circuit current (ISC)	…… A
Maximum system voltage	…….VDC
Module efficiency	……..%
Operating temperature	-……..˚C to +…….˚C
Temperature coefficient of PMPP	……%/°C
Dimensions	……..×……..×…….mm
Module area	…….m2
Weight	…….kg
Maximum load	……Pa
Material of module Frame /fasteners, bolts & nuts	
Front module surface (material used)	
Compliance with IEC 62804 -1	Yes/No (Append IEC Certificate)
Compliance with EN 50380	Yes/No (Append IEC Certificate)
Compliance with IEC 61215-1 and IEC 61215-2	Yes/No (Append IEC Certificates)
Compliance with IEC 61701	Yes/No (Append IEC Certificate)
Compliance with IEC 61730-1 and IEC 61730-2	Yes/No (Append IEC Certificates)
Compliance with IEC 61853-1	Yes/No (Append IEC Certificate)
Compliance with IEC 62979	Yes/No (Append IEC Certificate)
Type of junction box IP 65 – Data Sheet attached	Yes/No
Product warranty	……..years
Product warranty terms appended?	Yes/No

Performance Guarantee	……% after 10 years and ……% after 25 years
Warranty to meet above Performance appended?	Yes/No

Sheet 2 – Inverter Modules

Inverter Datasheet Information	
Manufacturer	
Inverter Model	……
Inputs	
Maximum DC Power	……
MPP Voltage Range	…..V to …..V
Maximum Input Voltage	……V
Maximum Input Current / MPPT	……A
Number of MPP Trackers	…….
Outputs	
Rated AC Power at 25°C	……..kVA
Maximum AC Output Current	……..A
Rated AC Voltage	……..V
AC Grid Frequency	50Hz
Efficiency	
Maximum Efficiency	……%
Standby Consumption	< …….W
Operation Consumption	…….W
General Data	
IP Rating	……..
Operating Temperature Range	……..°C to ……..°C
Relative Humidity	….-….. %
Dimensions (H x W x D)	…….. x ……. x ……mm
Weight (kg)	……..kg
Enclosure Material	
Certificate of Compliance	
Compliance with IEC 62894	Yes/No (Append IEC Certificate)
Compliance with IEC 62109 Parts 1, 2 and 3	Yes/No (Append IEC Certificates)
Compliance with IEC TS 62910	Yes/No (Append IEC Certificate)
Compliance with IEC 62920	Yes/No (Append IEC Certificate)
Compliance with IEC 61683	Yes/No (Append IEC Certificate)
Compliance with IEC 62116	Yes/No (Append IEC Certificate)
Compliance with IEC 60529	Yes/No (Append IEC Certificate)
Compliance with IEC 62852	Yes/No (Append IEC Certificate)
Product warranty	……..years
Product warranty terms appended?	Yes/No

Sheet 3 – Mounting Structure for Photovoltaic Modules

Mounting Structure Specifications	
Manufacturer /Supplier	……
Material used for structure	……
Materials for fasteners, bolts and nuts.	
Tilt Angle	
Inter - Row spacing	……..
Module configuration	Portrait/landscape
Ground Cover Ratio	
Designed to withstand wind speed	…… km/hr (Detailed design to be submitted after award)
Suitable for soil acidity/marine atmosphere?	Yes/No
Product warranty	……..years
Product warranty terms appended?	Yes/No

Sheet 4- Oil Type Transformers for Solar Compact Stations

Items	Description	Units	
1.	Continuous maximum rating (CMR) at rated voltage with ONAN cooling	kVA	
2.	Is transformer totally oil-filled with no gas cushion?	Yes/No	
3.	Current rating – Amps H.V L.V	 A A	
4.	Winding connection Vector Group Symbol		
5.	Impedance Voltage	%	
6.	Normal ratio of transformation at no load		
7.	Total range of variation of transformation ratio	±%	
8.	Size of steps	%	
9.	Tappings on H.V. winding	Yes/No	
10.	Regulation at 75°C and at full load as percentage of normal voltage (a) At unity p.f. (b) At 0.8 p.f. lagging	 % %	
11.	Fixed losses at normal ratio and 75°C	kW	
12.	Load losses at normal ratio and 75°C at full rated power	kW	
13.	Ratio on Inrush Current to Primary Current at 0.3 sec after energising transformer		
14.	Efficiency at normal ratio and 75°C at: (a) Rated power at unity power factor (b) Rated power at 0.8 power factor (c) Natural circulation rating	 % % %	
15.	Winding temperature:- Hottest spot temperature at full rated power (assuming an air temperature at 32°C approx.)	 °C	
16.	Maximum observable top oil temperature at:- (a) Full rated power (assuming an air temperature at 32°C) approx. (b) Natural circulation rating (assuming an air temperature 32°C) approx.	 ºC ºC	
17.	Calculated ONAN thermal time constant	Hrs	
18.	Type of transformer – shell or core		
19.	Type of core joint - butt or mitred		
20.	Type of core sheet - cold rolled or hot rolled		
21.	Maximum current density in windings:-		

	H.V. L.V.	kA/sq.m kA/sq.m	
22.	Whether special surge protection is provided in conjunction with modified end-turn reinforcement	Yes/No	
23.	Type of axial coil supports:- (a) H.V. winding (b) L.V. winding		
24.	Type of radial coil supports:- (a) H.V. winding (b) L.V. winding		
25.	Can winding be removed for repairs?		
26.	Total quantity of oil required to fill complete transformer		
27.	Standard specifications of oil used for filling transformer		
28.	Is transformer externally hot dip galvanised?	Yes/No	
29.	Required for each transformer:- (a) Weight of copper (W) (b) Weight of core sheets (c) Weight of all other ferrous parts	 kg kg kg	
30.	Approximate weight of core and winding assembly	kg	
31.	Total weight of transformer complete as in service	kg	
32.	Approximate dimensions of transformer incl. all fittings:- (a) Length (b) Breadth (c) Height	 mm mm mm	
33.	Windings:- (a) Type of winding - H.V. - L.V (b) Wire size - H.V. L.V. (c) Type of wire insulation (d) Number of coils per winding (e) Number of turns per coil (f) Number of layers per coil (g) Number of turns per layer (h) Type of insulation between layers (i) Thickness of insulation between layers (j) Turn numbers in tapping coils (k) Total length of winding (l) Winding & clearances from yokes (m) Interphase winding clearance (n) Total weight of copper per phase	 mm mm mm kg	

	(o) Limb diameter Limb length Limb centre distance (p) Top yoke clearance from tank cover (q) Whether tapping connection are of the crimped type?	mm mm mm mm Yes/No	

Sheet 5 - Mineral Insulating Oil for Transformers

Items	Description	Units	
1.	Sludge Value (max.)	%	
2.	Acidity after oxidisation (max.)	mg KOH/g	
3.	Flash point (closed) – min.	ºC	
4.	Viscosity:- (a) at 15ºC (max.) (b) at 20ºC (max.)	 mm²/s mm²/s	
5.	Pour point (max.)	ºC	
6.	Electric strength (breakdown) min. for oil received in Mauritius in drums	kV/mm	
7.	Acidity (neutralisation value) – max.	mg KOH/g	
8.	Corrosive sulphur		
9.	Water content (max.) for oil received in Mauritius in drums	p.p.m.	
10.	Density at 20ºC (max.)	g/ml	
11.	Loss tangent at 90ºC (max.)		
12.	Resistivity		
13.	Polycyclic aromatic content (IP 346)	%	
14.	Polychlorinated Biphenyls	(mg/kg)	
15.	Reference of standard specifications		
16.	Are any precautions to be taken in compliance with the EEC Dangerous Substance Directive 67/548/EEC?	Yes/No	

Sheet 7 - Incoming Feeder Panel

Items	Description	Units	
1.	Rated Voltage	kV	
2.	Rated Current	A	
3.	Rated short time current	Isc [kA(rms)]	
4.	Making Capacity	kA peak	
5.	Arc quenching medium e.g. SF_6/ Vacuum	To specify	
6.	Is double or single break?	To specify	
7.	Type of operating mechanism (motorised spring charged)	Yes/No	
8.	**A. Minimum clearance:** (a) Between phases (b) Live part to earth	 mm mm	
9.	**B. Type of design contacts:** **C. (a) Movable contacts** **D. (b) Fixed contacts**	To specify	
10.	**E. Type of metal used for contacts:** **F. (a) Movable contacts** **G. (b) Fixed contacts**	To specify	
11.	**H. Padlocking facility to allow locking of disconnector and earth switch in close/open positions independently**	Yes/No	
12.	**I. Are all signals required as per Employer Requirement being provided?**	Yes/No	
13.	**J. Does load break switch disconnector have both local and remote mode of operations?**	Yes/ No	

Sheet 8- Voltage Transformer Panel

Serial No.	Description	Units		
1.	Rated Voltage	kV		
2.	Rated Current	A		
3.	Type of Disconnector	To specify		
4.	Type of operating mechanism of Disconnector	To specify		
5.	Standard of HRC fuse links	To specify		
6.	Voltage Transformer:- (a) Number of units installed (b) Type (c) Model/Make			
			Metering core	Protection core
	(d) Burden (e) Rated primary voltage (f) Rated secondary voltage (g) Accuracy class (h) Transformation ratio (i) Rated thermal output	VA kV V VA		
7.	**Padlocking facility to allow locking of disconnector and earth switch in close/open positions independently**	Yes/No		

Sheet 9- Circuit Breaker Panel

S. No.	Description	Units	
1.	Rated Voltage	kV	
2.	Rated Current	A	
3.	Rated short time current	I_{SC} [kA(rms)]	
4.	Making Capacity	kA peak	
5.	Arc quenching medium e.g. SF_6/ Vacuum	To specify	
6.	Type of operating mechanism (motorised spring charged)	Yes/No	
7.	**K. Minimum clearance:-** (a) Between phases (b) Live part to earth	 mm mm	
8.	**L. Type of design contacts:-** **M. (a) Movable contacts** **N. (b) Fixed contacts**		
9.	**O. Type of metal used for contacts:-** **P. (a) Movable contacts** **Q. (b) Fixed contacts**	To specify	
10.	**R. Padlocking facility to allow**	Yes/No	

	locking of disconnector and earth switch in close/open positions independently		
11.	**S. Current Transformer:-** **T. (a) No. of CT provided** **U. (b) Type** **V. (c) Model/Make** **W. (d) Burden for protection** **X. (e) Burden for metering** **Y. (f) Accuracy class for protection** **Z. (g) Accuracy class for metering** **AA. (h) Rated primary current** **BB. (i) Rated secondary current** **CC. (j) No. of primaries**	 VA VA A A	
12.	**DD. Does CEB Circuit Breaker have both local and remote mode of operations?**	Yes/ No	
13.	**EE. Are all signals required as per Employer Requirement being provided?**	Yes/No	
14.	**FF. Has interlocking/ inter-tripping feature been provided between CEB Circuit Breaker and all Client Circuit Breakers**	Yes/ No	

Sheet 9- Complete Switchboard of MV Substation

Item No.	Description	Units	Value
1.	Rated Voltage	kV	
2.	Impulse test voltage 1,2/50µs	kV	
3.	Rated short time current-IS	kA-1sec	
4.	Electrodynamic withstand	kApeak	
5.	Type of busbars (copper/aluminium)		
6.	Are busbars insulated?	Yes/No	
7.	Busbar Rating	A	
8.	Degree of Protection	IP	
9.	Colour of switchboard		
10.	Dimensions of switchboard when assembled:- (i) Length (ii) Depth (iii) Height	 mm mm mm	
11	Internal Arc Classification (IAC)	AFLR	
12.	Reference of IEC standards to which switchboard complies with	To specify	

Sheet 10- Guaranteed Net Electrical Power from PV Plant

The Bidder guarantees the following performance failing which it shall be liable to pay for liquidated damages as per provisions of Section 11 of the Standard Bidding Document.

- Guaranteed Net Electrical Output Capacity $(MWac)_G$ = …….. MWac at site ambient temperature of …….. °C.

- Temperature Coefficient Cp = …… %/°C (in this case from module manufacturer) as submitted in their bid.

XIII SCHEDULE OF WORKS COMPLETION

[Bidders to fill in the Completion Schedule]

Physical unit	PV Farm Capacity	Works Site	Employer's Required Completion time from Commencement Date	Bidder's Response for Completion time from Commencement Date
1	1MWac	Grenade - Rodrigues	12 months	

Section 8. Drawings & Other Documents

Section 8. Drawings & Other Documents

Part 1 - List of Drawings attached:

Drawing No	***Description***
S-5191	Site Layout for 1MWac Solar PV Farm at Grenade
R-GRE-EL01	Single Line Diagram
R-GRE-EL02	22kV Solar PV Switchgear
R-GRE-EL-03	Transformer and LV AC Room
6118-12	Typical Section thru' Drawpit for LV UG Cables (4 Sleeves)
6549-17	Typical Road Crossing + Conc Jacket 4 PVC 160mm + 2 PVC 63mm Sleeves
6550-17	Trench Along Road 4 PVC 160mm + 2 PVC 63mm Sleeves
6640-18	Typical Arrangement for Wooden Cable Support (HT Metering Switchgear)
6645-18	Standard Drawing for HT Metering Switchgear (with double sectionaliser)
6766-19	Soakage Pit Details

Part 2- Other Documents attached:

Document No	***Description***
1	BLUP Guide
2	Existing Underground Services at Grenade Wind Farm
3	Geotechnical Investigation Factual Report for Grenade Wind Farm