RURAL ELECTRIFICATION FUND

Supply, delivery and supervision of the installation process of Solar equipment for community solar mini-grids

INTERNATIONAL COMPETITIVE TENDER

TENDER NUMBER:	**REF/INTER/07/09/2021**
CLOSING DATE:	**...14 OCTOBER 2021**
CLOSING TIME:	**.....1000HOURS**
DATE OF ADVERT	**....16 SEPTEMBER 2021**
REFUNDABLE TENDER FEE:	**FREE**

SUBMISSION OF BIDS/TENDERS

All bids/tenders must be deposited in the Tender Box located at:

Rural Electrification Fund
Room 713 7th Floor, Megawatt House
44 Samora Machel Avenue
HARARE
ZIMBABWE

RURAL ELECTRIFICATION FUND

DECLARATION BY THE ACCOUNTING OFFICER IN TERMS OF SECTION 19(2)(C) OF THE PUBLIC PROCUREMENT AND DISPOSAL OF PUBLIC ASSETS REGULATIONS,2018.

TENDER NUMBER: REF/INTER/~~02~~ 07 /~~05~~ 09 /2021

TENDER DESCRIPTION- Supply,delivery and supervision of the installation process of Solar equipment for community solar mini-grids systems

DECLARATION

The procurement for the tendered services is based on neutral and fair technical requirements and bidder qualifications.

Signed

.....

J.V MASHAMBA
CHIEF EXECUTIVE OFFICER

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1.0 SCOPE OF SUPPLIES

This document is a Bidding Document (BD) for the Supply,delivery and supervision of the installation process of Solar equipment for community solar mini-grids as specified in the Technical Specifications section of this document. The procurement for the tendered services is based on neutral and fair technical requirements and bidder qualifications. The Lots or sites as follows:

Lot No.	Province	District	Site Name
1	Manicaland	Chipinge	Hwakwata
2	Mashonaland Central	Muzarabani	Chiwenga
3	Mashonaland East	UMP	Chiwore
4	Mashonaland West		Dete
5	Masvingo	Gutu	Soti Source
6	Matabeleland South	Beitbridge	Chitulipasi
7	Midlands	Gokwe North	Gandavaroyi

2.0. TERMS AND CONDITIONS TO BE OBSERVED IN TENDERING

2.1 Terms and conditions

The tender and any contract shall be governed by the Public Procurement and Disposal of Public Assets Act (Cap 22:23) and the Public Procurement and Disposal of Public Assets Regulations, 2018. Orders will be placed by and/or contracts entered into by and between the Rural Electrification Fund (REF) and the successful bidder after approval of the tender in whole or in part by Rural Electrification Fund (REF). REF shall not accept any liability for any order/contract(s) which does not bear the authentic signature of anyone of the authorized signatories at the time of placement of the order/contract. The authorized signatories are the Executive Director Finance, and the Chief Executive.

The Tenderer must acquaint himself/herself with the **"Terms and conditions to be observed in tendering"**. The Purchaser shall not be responsible for any misunderstanding of incorrect information however obtained except information given in writing by the Purchaser.

2.2 Cost of Tender

Bidders shall bear all costs associated with the preparation and submission of their bids.
REF will be not responsible or liable for any such costs incurred by the bidders, regardless of the outcome of the Tender Process.

2.3 Tender Documents

Suppliers are expected to examine carefully the whole tender document. Failure to furnish all the information required in the bid document or submission of Tender not substantially responsive to the said document in every respect will be at the Supplier's risk and may result in rejection of the bid.

2.4 Tender Queries and Clarifications

All queries regarding the tender shall be forwarded by the bidding company in writing on duly signed company letterhead by hand to Rural Electrification Fund 7th Floor, Megawatt House, 44 Samora Machel Avenue, Harare, Zimbabwe, not later than four (4) calendar days from the closing date of the tender. Clarifications pertaining to the queries received shall be forwarded to all prospective Tenderers not later than three (3) calendar days from the date the query was received. If a prospective tenderer sends a query less than the stated days above, the query shall not be responded. Any neglect, delay or failure on the part of the Tenderer to obtain additional information on the above or any other matters, which the tenderer considers necessary, shall not relieve him/her from responsibility as a Tenderer.

2.5 Tender Responses

Suppliers wishing to respond to the tender must submit two envelopes, one for the technical containing responses related to the terms and conditions of the tender (evaluation criteria) and the financial envelope. Each envelope shall have three (3) copies of bid documents deposited in a sealed form at the Tender Box situated at:

Rural Electrification Fund
Room 713 7th Floor, Megawatt House
44 Samora Machel Avenue
Harare
Zimbabwe

By not later than 10.00am on the advertised closing date. Prospective suppliers may attend the opening of tender at Megawatt House, 7th Floor on the above

2.10 Errors of Extension or addition

The Rural Electrification Fund reserves the right to adjust arithmetical in the bid total price. Any adjustments made by the Rural Electrification Fund to a bid total price will be stated to the bidder prior to the acceptance of the bid, and will be made on the basis that the unit price is taken as correct and all extensions and additions will be adjusted accordingly.

In such cases the effect will be that the total amount of the bid will be altered so that this amount agrees with the amount arrived at after the errors of extension or additions have been corrected

2.11 Penalties/Liquidated damages

The purchaser shall without prejudice to its other remedies under the contract, deduct from the contract price, as liquidated damages, sum equivalent to 0.5% of contract price of the delayed service delivery for each week of delay until actual delivery, up to a maximum of 10% of the tender sum.

2.12 Delivery Period

The successful bidder is expected to deliver the goods within the delivery period stated in the bid document from the date of the Purchase Order or signing of agreement. The delivery period must be stated in weeks.
REF reserves the right to reject any deliveries, submissions or items that do not meet the specifications provided in this tender.

2.13 Company Profile

The company profile to include financial details such as Banking Institution Name; Bank Key: Branch; Town/City; Bank Account Number; Type of Account; Account Holder Name; and Sort/Swift Code. VAT registered companies to provide vat number. Provide full name of a person who is authorized to sign for and behalf of the company, cell phone number, email and physical address.

2.14 Bid Preparation

The bid shall be prepared in typewritten indelible ink. Bids must be properly spirally bound. A clearly labeled table of contents with correct page numbers or index must be provided on the second page of the bid document. Company name, tender number, tender description, closing date must be displayed on the cover page of the bid document. ALL HAND WRITTEN BIDS SHALL BE REJECTED AS NON-COMPLIANT.

2.15 Bid Bond/Security

Bidders must submit a refundable Bid Security of ZW$175,000.00 valid for 90 Days, together with their bid in line with Section 26 of the Procurement Regulations (S.I.5) of 2018). Foreign bidders shall attach a bid security of equivalent value in the currency of their bid. The Bid Security shall be payable using the below Options:
Option 1.....A certified Bank Cheque
Option 2.....A Bank Guarantee
Option 3.....A Cash Deposit to the PRAZ

If Option 3 is chosen bidders must also submit proof of payment to Procurement Regulatory Authority of Zimbabwe (PRAZ) of non-refundable cash bid bond establishment fee equivalent to ZW$40,000.00 for domestic bidders and USD500.00 for foreign bidders in line with Part V of the Statutory Instrument(S.I)219 of 2020.Failure to comply with the above will lead to automatic disqualification.

2.16 Administration Fees for Special Oversight Committee(SPOC)

The tender is subject to review by Special Oversight Committee (SPOC)in terms of section 54 of the Public Procurement and Disposal of Public Assets Act. Accordingly, Bidders should pay a non-refundable administration fee of ZW$16,000.00 payable to the Procurement Regulatory Authority of Zimbabwe. Proof of payment must be submitted together with the Bid documents. Foreign bidders shall pay a non refundable fee of USD$200.00 accordingly.

2.17 Contract Administration Fee Payable by the Contractors

Bidders are advised that the winning bidder shall be required to pay contract administration fees in line with S.I 219 of 2020 Part VI. **Bidders are encouraged to determine the applicable fees before submission of bids.**

2.18 Companies owned by same person

No bidder may submit more than one bid, either individually or as a joint venture partner in another bid, except as a subcontractor and a conflict of interest will be deemed to arise if bids are received from more than one bidder owned, directly or indirectly, by the same person. REF shall disqualify both bids in case of such a conflict of interest.

3.0. EVALUATION CRITERIA

The evaluation criteria of the tender shall include the below listed requirements. Bidders who fail to comply with any of the clauses below may be disqualified from the tender as their bid will not be compliant.

3.1 Compliance to technical specifications- Bidders must complete the Requirement table per system. However for the Bill of Quantities(BOQ) you fill per site(provided under the technical specifications clause). Bids without completed or incorrectly completed technical guarantee tables will be rejected as non-compliant.

3.2 Bidders must submit the following company documents without fail:

- A Certificate of Incorporation - in terms of the Companies Act (Chapter 24.03).
- or equivalent registration document in country of residence.
- CR14- indicating names and addresses of the directors and their shareholding Structure.
- CR 6 Form -principal place of business
- Proof of registration with Zimbabwe Revenue Authority (ZIMRA) - in the form of a valid current tax clearance certificate ITF 263 and VAT registered companies in addition to submit VAT Certificate.
- Proof of current registration/clearance with National Social Security Authority(NSSA).

3.3 Price-Bidders MUST use the pricing format below.
Failure to use the correct pricing format may lead to disqualification:

SUMMARY PRICING TABLE

Lot No.	Province	Site Name	Unit Price VAT Excl USD	Unit Price (ZW$) VAT Excl	Total VAT ZW$ Incl	Total Price VAT Incl ZW$
1	Manicaland	Hwakwata				
2	Mashonaland Central	Chiwenga				
3	Mashonaland East	Chiwore				
4	Mashonaland West	Dete				
5	Masvingo	Soti Source				
6	Matabeleland South	Chitulipasi				
7	Midlands	Gandavaroyi				

PRICING PER LOT- Each bid must have clear pricing per lot as shown on the table below without fail. Bids without the pricing format below shall be rejected as non-compliant.

LOT NO:1-Supply and delivery of solar equipment for Chipinge site

DESCRIPTION OF COMPONENTS QUOTED. (Bidders must clearly state the cost of components per lot including the cost of supervision)	QTY (each)	Unit Price VAT Excl USD	Unit Price (ZW$) VAT Excl	Total price Incl (RTGS$)
Xxxxxxxxx				
Xxxxxxxxx				
Xxxxxxxxxx				

LOT NO:2-Supply and delivery of solar equipment for Chiwenga site

DESCRIPTION OF COMPONENTS QUOTED. (Bidders must clearly state the cost of components per lot including the cost of supervision)	QTY (each)	Unit Price VAT Excl USD	Unit Price (ZW$) VAT Excl	Total price Incl (RTGS$)
Xxxxxxxxx				
Xxxxxxxxx				
Xxxxxxxxxx				

- Dual pricing in terms of Statutory Instrument (S.I) 185 of 2020-Bidders must quote their bid prices both in USD and the RTGS currency using the prevailing exchange rate. **Bidders must state the exchange rate used.**
- Bids that use a non existent exchange rate shall be rejected as non compliant.
- Bidders must STATE the exchange rate used and ATTACH the proof of the exchange rate used. Attach proof from the bank without fail.
- Payment shall be strictly in local currency at the prevailing exchange rate.
- The bid price should **clearly and separately** show the unit price and the total price of the equipment to be supplied.
- Bidders are allowed to bid for one or more lots.
- REF reserves the right to reduce the scope of work per lot depending with availability of financial resources.
- The ZW$ prices shall be used for purposes of tender evaluation.
- Bidders MUST state clearly whether they charge VAT or not.

3.4. Payment terms- REF prefers payment after delivery, however where a bidder require pre-delivery payment they must state ability to secure a bank guarantee from a registered commercial bank acceptable to REF equal to the amount to be advanced. The bank guarantee must be provided within two weeks of contract signing. NOTE: Foreign bidders must provide a bank guarantee confirmed and backed by any local commercial banks or provide a bank guarantee issued by any local banks.

3.5. The bid prices must be quoted Delivered Duty Paid DDP (2020),that means including the cost and risk of freight and all import costs until delivery. Bidders must state that the bid price is DDP(2020). The supplier shall deliver the equipment to REF Central stores located at number 22A James Martin Road Lochinvar Harare, Zimbabwe.

3.6 Reference letters- The bidder must provide three reference letters for (3) similar projects they did in the last five (5) years. At least 1 of the project should be in Zimbabwe, References more than five (5) years old will be rejected.**The reference letters must therefore clearly state the size of the solar systems installed.**

3.7 Company competences- The design team members must have the following competences and experience in the stated fields of expertise. The competences below shall be stated or provided in the staff CVs and supported by relevant certified certificates (please attach the certificates):

- Solar systems design and installation (bidders must attach a Degree Certificate in Electrical Engineering/Electronic / Renewable Energy Degree)
- Civil / structural installations (Bidders must attach a Degree in Civil Engineering)
- Prepaid metering (software and hardware) bidders must attach a Degree Certificate in Electrical Engineering/ Electronic or Software Engineering Degree).
- The company must have successfully undertaken at least 3 projects of a similar nature or size before.

3.8 Proof of quality certification(ISO)- the solar equipment must be manufactured by internationally recognized quality certification organization. Attach proof of the quality certification for the manufacturer of the equipment.

3.9 Letter of agency-Bidders must attach a letter of agency issued by the manufacturer or principal distributor of the solar equipment without fail.

3.10 Bidders must be registered with the Procurement Regulatory Authority of Zimbabwe (PRAZ) - Bidders must attach proof of registration with PRAZ on the list for engineering or consultancy services. In case tender is awarded to foreign bidders who are not PRAZ registered, such bidders shall be required to register with PRAZ before contract signature.

3.11 This is an equipment supply and provision of construction supervision services tender. The bidder must indicate that they shall provide personnel that shall

supervise the construction of the mini-grids by REF personnel and their qualification and experience.

3.12 REF reserves the right to amend tender/contract scope at the evaluation stage in line with budget resources available.

3.13 Bidders must state the required payment terms. REF favors payment after delivery, however where bidders require pre-delivery payment they must state ability to secure a bank guarantee from a registered commercial bank acceptable to REF equal to the amount to be advanced. The bank guarantee must be provided within two weeks of contract signing.

3.14 Delivery period- the maximum delivery period for the equipment is **12 weeks.** Bidders must state a delivery period accordingly.

3.15 Compulsory Site Visit- there is no site visit scheduled for this tender.

3.16 Bidders must STATE that they are prepared to accept payment in local currency only (RTGS$). Bidders must provide their local bank account details without fail.

3.17 Bidders MUST must clearly state in their bids that they have checked that the goods tendered "fall" or "do not fall" under the Consignment Based Conformity Assessment (CBCA) programme as required by the Government of Zimbabwe. If the goods tendered "fall" under the CBCA programme, bidders must further state that all costs associated with this requirement will be to the supplier's account.

3.18 Compliance with SPOC administration fees-Bidders must attach proof of payment for SPOC administration fees as per clause 2.16 of the RFP.

3.19 Bid bond compliance-Bidders must attach proof of bid bond compliance as per clause 2.15 of the Bidding Document without fail.

3.20 Bid validity of a minimum of 90 days is required and must be clearly stated.

3.21 Warranty period-Bidders must state a warranty period of 12months against manufacturer's defects.

3.22 REF reserves the right to reject any deliveries that do not comply with the tender specifications at the point of delivery.

3.23 Tenders must be submitted in three (3) copies and the ORIGINAL" copy must be clearly marked.

3.24 The Bidders must submit the bid with a duly filled in and signed Declaration on Non-Engagement in Corrupt or Fraudulent Practices Form APPENDIX 6.Bidders shall complete this form in ink only.

3.25 The bidder must submit with the bid a duly filled in and signed attached Form of Tender Annexure 3. Bidders shall complete this form in ink only.

4.0 FINANCIAL INFORMATION

All prices must be inclusive of all costs required in the implementation of this tender. The delivery address is: REF Central stores located at number 22A James Martin Road Lochinvar Harare, Zimbabwe.

All VAT registered supplier must show VAT separately in their bid. All equipment necessary for the execution of the tender is to bidders account.

5.0 AWARD CRITERIA

Tender shall be awarded to the lowest priced bidder to specification for all the lots. This means the tender shall be awarded to a sole bidder with the lowest total price to specifications for all the lots. This is mearnt to ensure standardization of equipment supplied.

6.0 CONTACTING THE PURCHASER

Any effort by the bidder to influence REF in the tender evaluation, tender comparison, and contract award or order placement decisions will result in the rejection of the bidder's bid.

7.0 CONFIDENTIALITY

After the public opening of tenders, information relating to the examination, clarification, evaluation and comparison of tenders and recommendations concerning the award of the contract shall not be disclosed to bidders or other persons not officially concerned with such process until the award of contract is announced. **No bidder shall contact the Purchaser on any matter relating to this** tender, from the time of the tender opening to the time the tender is awarded. Any bidder in possession of confidential tender information will be obliged to reveal the source of information and/or face disqualification of their bid.

8.0 CORRUPT OR FRAUDULENT PRACTICES

Rural Electrification Fund requires that Tenderers observe the highest standard of ethics during the procurement process and execution of contracts. A tenderer shall sign and submit together with the bid the attached form (Annexure 2), that states that they have not or will not be involved in corrupt or fraudulent practices.
Rural Electrification Fund will reject a proposal for award if it determines that the tenderer has engaged in corrupt of fraudulent practices in competing for the contract. A Tenderer who is found to have indulged in corrupt or fraudulent practices will be automatically disqualified.

9.0 SUBMISSION OF BIDS

9.1 The tender must be enclosed in sealed envelopes, endorsed on the outside with the advertised tender number, the closing date and description of tender and

must be send by courier in time to be submitted or deposited in the Tender Box situated at, **Rural Electrification Fund, Room 713, 7th Floor Megawatt House, 44 Samora Machel Avenue, Harare,** by 10.00 hours on the closing date notified.

9.2 Tenders which are properly addressed to the Procurement Administrator in envelopes with the advertised tender number, the closing date and tender description endorsed on the outside are not opened until 1000 hours on the closing date.

9.3 **Note:** Tenders which are not received by 1000 hours on the closing date whether by hand or by courier will be treated as late tenders and will be rejected.

9.4 Tele-fax and e-mail bids are not accepted i.e. electronic bidding is not accepted.

9.5 Any tender submitted that does not fully comply with the above terms and conditions will be rejected without further consideration as will tenders received after the published closing date.

9.6 Bidders are required to adhere to the instructions regarding preparation and submission of tenders as those who do not comply will be disqualified.

9.7 Tenderers are free to attend and witness the public tender opening at the above captioned address. The opening ceremony shall be done on the tender closing date soon after the closing time.

10.0 RIGHT FOR ACCEPTANCE OR REJECTION OF ANY OR ALL BIDS

The Fund reserves the right to accept the whole or part of the tender. The Fund reserves the right to accept or reject any bid and to annul tendering process and reject all bids at any time prior to award of contract/order, without incurring any liability to the affected Tenderer(s) or obligations to inform the affected Tenderer(s).

11. INTERCHANGEABILITY BETWEEN BIDDER AND DEVELOPER

Respondents should note that the words bidder(s) and developer(s) are used interchangeably in this tender. Developer(s) is typically used for entities that set-up and run mini-grids

12. TECHNICAL SPECIFICATIONS SECTION OF THE TENDER

Instructions to bidders

Bidders are required to study the technical specifications per size of each solar system. Bidders must complete the Requirements table per system(provided from clause 15). However for the Bill of Quantities(BOQ) you fill per site(provided under the technical specifications clause). each Lot. Bids not complying with this requirement shall be rejected as non-compliant.

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PART II: TECHNICAL REQUIREMENTS FOR SOLAR PHOTOVOLTAIC MINI-GRID POWER GENERATION

2021

12. PROJECT OVERVIEW

Mini-Grid Solar Project is a project that aims to supply clean and affordable power for whose rural areas that have not been access to grid.

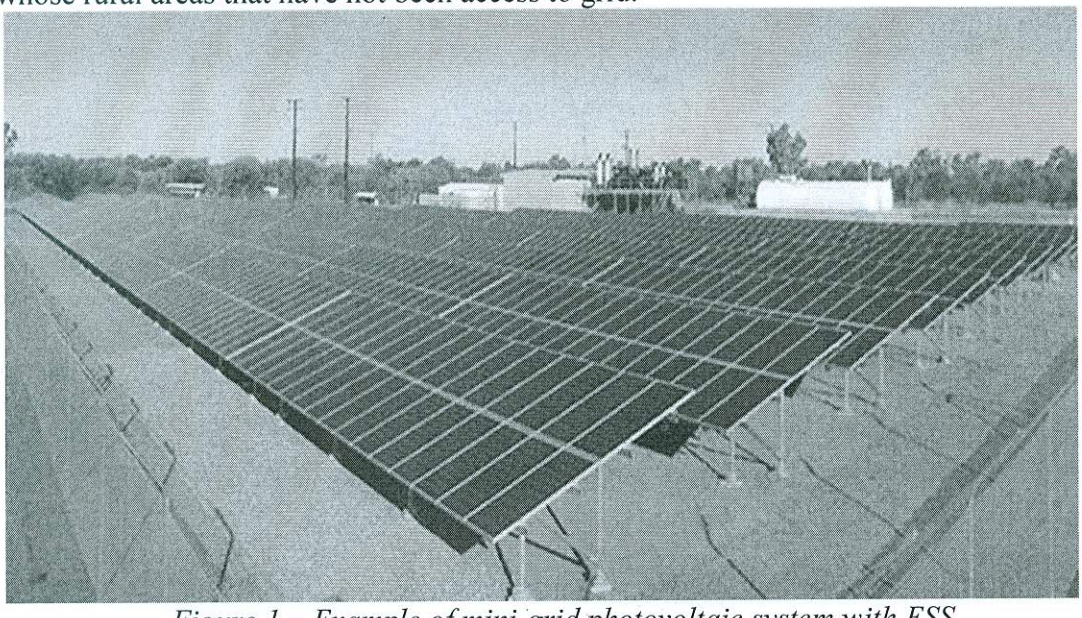

Figure 1 – Example of mini-grid photovoltaic system with ESS

The project shall be done by the Rural Electrification Fund (REF), which is a statutory body governed by the Rural Electrification Fund Act 2002 (Chapter13:20). The mission of REF is empowerment of rural communities of Zimbabwe through harnessing of energy resources to ensure that all the people have access to, and make productive use of, adequate, reliable, least-cost and environmentally sustainable energy services. The vision is to provide a universal access to modern energy services by 2030.

13. GENERAL REQUIREMENT

13.1 Mini-Grid Pilot and Towns or Villages in Zimbabwe

The solar mini-grid with battery and diesel backup project is designed to provide electricity to households, institutions and businesses for Zimbabwe villages that are far away from the grid and will not be connected to grid electricity in the near future. The objective of this pilot project is to determine the technical, operational and financial feasibility of mini-grid solar power systems for such villages. REF has identified eight sites that need to be electrified using solar and battery storage systems with backup diesel generator. The scope of this bid is to finalize the high level design done by REF, supply the equipment required as per design and supervise REF personnel construct and commission the power generation system (PV array + ESS + diesel generator).

13.2 Quality and Integrity of Mini-Grid System Components

The bidding mini-grid developer shall unconditionally guarantee that the mini-grid equipment supplied shall be entirely of new manufacture using state of the art technology and not second hand, reconditioned and/or used equipment and shall

be of the highest quality to ensure system reliability and availability for which it is intended.

13.3 Mini-grid Equipment Guarantee

The system proposed by the developer shall be fully guaranteed against all defects. The developer shall guarantee to replace defective equipment or components electrical and/or mechanical within stated warranty period to establish normal operation of the entire system.

14 SYSTEM DESIGN REQUIREMENT

14.1 Mini-grid Loads PV Array, ESS, and Gen-set Sizes

The list of mini-grid sites is provided in the table below. PV Array, inverter and storage total (sizes) for each settlement and Gen-set sizes are shown.

Table 2: Mini-grid System Sizes for rural service centres and/or neighbouring Villages

No.	Province	District	Name	PV total capacity (kW_p)	Micro grid inverter total capacity (KW)	Battery Storage total capacity (kWh)
1	Manicaland	Chipinge	Hwakwata	152 kW	150kW	662.0
2	Mashonaland Central	Muzarabani	Chiwenga	15kW + 30kW	20kW + 30kW	165.6
3	Mashonaland East	UMP	Chiwore	60 kW	60kW	201.6
4	Mashonaland West		Dete	120kW	90kW	496.80
5	Masvingo	Gutu	Soti Source	160KW (150KW-AC Coupled+ 10KW- DC coupled)	• GTI-150KW • BBI≥126KW Isolation transformer ≥ 150KVA	614.4
6	Matabeleland South	Beitbridge	Chitulipasi	120	≥120	≥496,8
7	Midlands	Gokwe North	Gandavaroyi	96	≥90	≥336

Note: GTI-Grid Tie Inverter/PV inverter
BBI-Battery Based Inverter

14.2 Mandatory High-Level Requirements for Mini-Grid Systems

The solar mini-grid photovoltaic system is broken down into the following logical subsystems:

- Solar Photovoltaic Array and Support Structure – Includes solar panels and associated mounting structure.
- Energy Storage System (ESS) – Lithium ion battery bank.

- Micro grid Inverter System– Power converter unit that can be connected to PV panels, storage system, Generator-set, and conversion of the DC power to AC power, to power the loads. Includes Battery Management System and System Controller, Battery Module and Balancing System, Protection System and Metering.
- PV Array Cables
- AC Cables to distribution lines (as applicable)
- DC Cables to distribution lines (as applicable) inverter

14.3 Mini-Grid Topologies

DC coupled systems

Advanced system topologies can involve the system working in steady and high efficiency status, and ease of installation and maintenance. From the components outlined in Section 3.2 above, bidders are required to show the topology they are suggesting for connecting up the components here. A diagram to show the connectivity is suggested below. However, should bidders have alternative topologies, they are required to show them diagrammatically.

The Sub-systems of solutions are as follows:

- **Energy Plant System (EPS):** Transform energy in the sunlight to electricity power.
- **Energy Converter and Controller system (ECC)**: Convert the energy between DC and AC, responds to the command of a management system, achieves power conversion, and controls the bus voltage, in conjunction with energy storage to achieve the balance of power.
- **Energy Storage System (ESS):** Stores energy in the system and responds to calls from the inverter.
- **Energy Management System (EMS)**: remotely monitors the whole system working status, checks the system operation parameters and outputs and produces reports.
- **Diesel Generator system (D.G):** as optional, supply backup power in rainy days
- **Power Distribution System (PDS)**: Transmits and distributes the energy in the system, voltage and frequency are affected by ECS and LOAD.
- **Loads**: Make use of the energy, load fluctuates with the electricity consumption habits of consumers

This topology's core device is a mini-grid inverter cabinet, which is an all in one-power module comprising, bypass module, and DC&AC distribution boards and energy control unit. It incorporates an integrated PV MPPT controller, and bi-directional inverter. The DC power from PV is converted to AC power and feeds the load, while charging the battery directly at the same time.

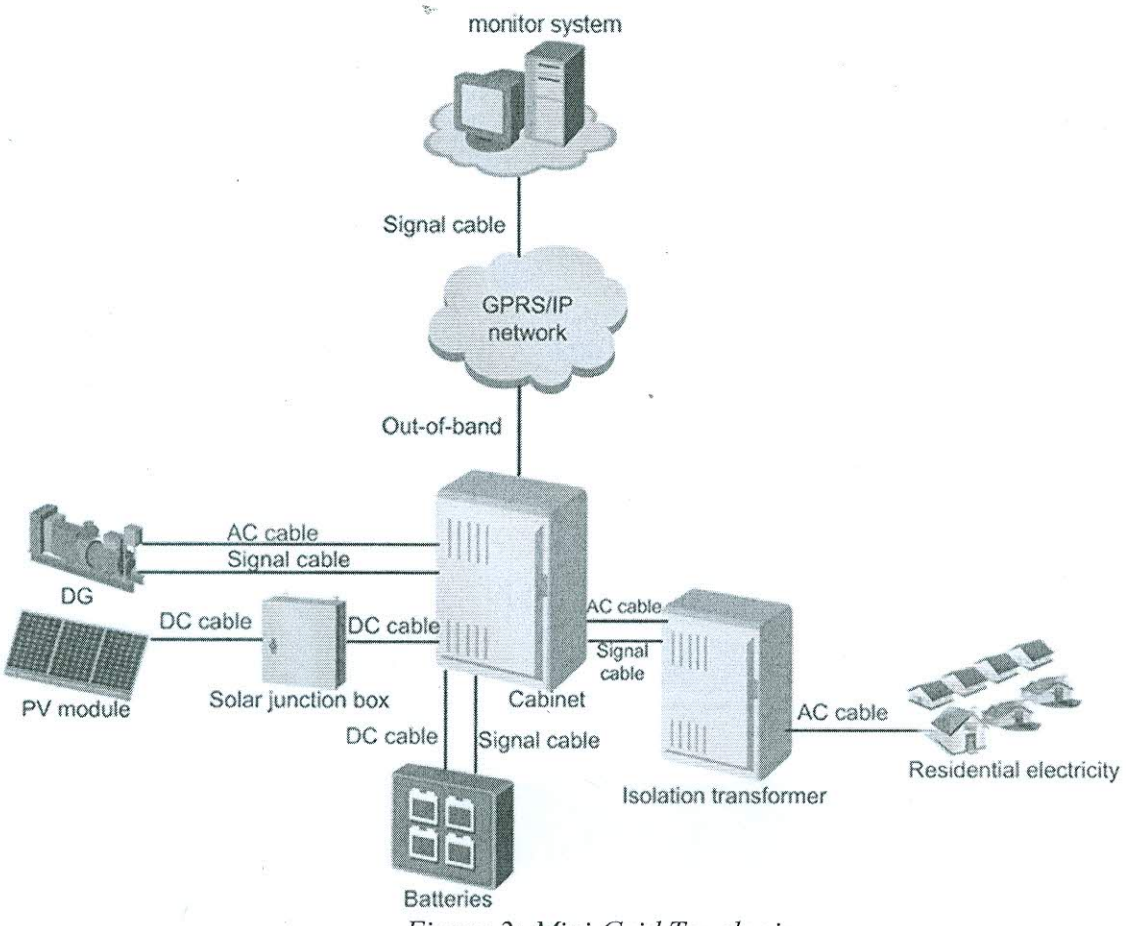

Figure 2: Mini-Grid Topologies

The working mode is as follow:

- In the daytime, when the solar energy is sufficient to supply power for the loads, solar controller commands that PV modules convert the solar energy to electric energy through the Integrated Converter and Controller and supply power to the loads and the redundant energy will be stored into the battery at the same time.
- On a cloudy day, PV panels and the batteries will provide the power which is converted by the Integrated Converter and Controller and supply power to the loads.
- At night or on rainy days, when the battery has enough power, the batteries will provide the power which is converted by the Integrated Converter and Controller and supply power to the loads.
- When battery energy is low, the D.G will start to provide power to the loads and charge the battery at the same time.
- When battery is fully charged, the D.G goes off and the battery will supply power to the loads. The output voltage of such topology is expected to be 400VAC nominal.

The system shall be a DC coupled system and this configuration is mandatory. The system must meet the following topologies :

All in one mini-grid topology

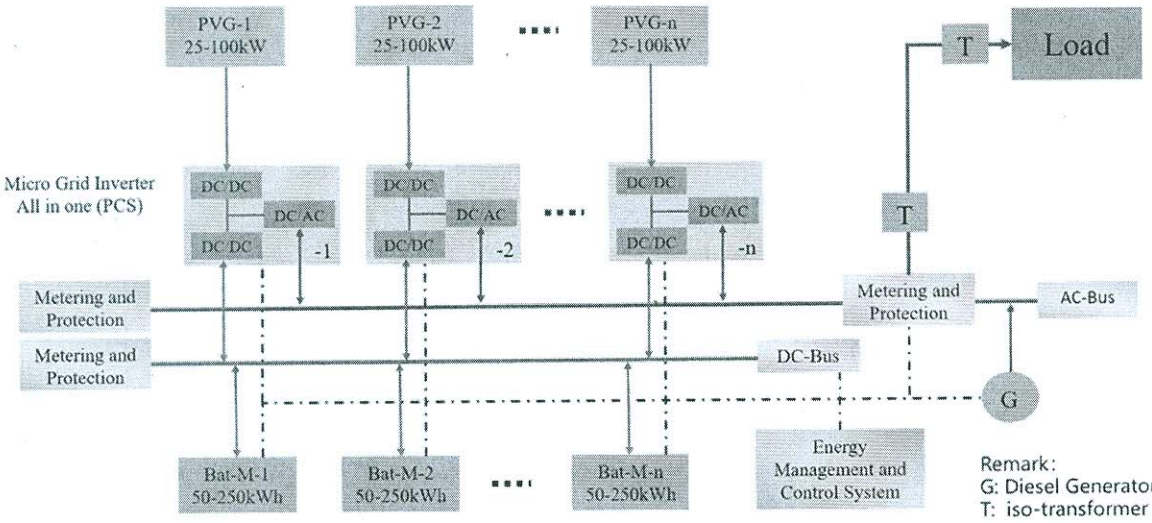

Figure 3: Internal topology of the system

The wiring diagrams for the system components and ancillaries and associated bus-bar shall be provided to show the inter-connectedness of the components to make up the system. The above is just a schematic to illustrate the topology.

AC coupled system: Soti Source solar Mini grid only

The system shall be an off-grid AC coupled system and this configuration is mandatory. The Sub-systems of the solution are as follows:

1. **Main solar PV Generator (150kW)**: This generates the bulk of the energy and feeds the GTI/ PV inverters.
2. **Auxiliary solar PV array (10KW)**: this charges the battery bank directly through MPPT charge controllers. The auxiliary PV generator allows for the system black start in cases where the system shuts down due to low battery bank voltage usually in the evening. This becomes important in cases where the diesel generator is out on service and the system needs charge directly for the BBI inverters to provide a mini grid for PV inverters to operate during the day.
3. **Inverter system**: the inverter system has two sets of inverters, that is, the GTI inverters and the Battery Based (BBI) inverters. The Grid Tied Invertors (GTI) requires micro grid reference from the BBI inverters /diesel generator to supply power directly to AC loads during the day. Excess power after supplying the AC loads is fed to the battery through bidirectional BBI inverters. The BBI inverters supply the loads during the night and in cases where the PV inverters are not supplying enough power, the BBI inverters supplies the balance of the load requirement.
4. **ESS (battery bank):** Stores energy in the system and responds to calls from the BBI inverter for supply of power and this happens usually during the night or periods of low solar irradiation.

5. **Diesel generator (DG):** The DG has been incorporated to cover for the rather short autonomy period provided by the battery. The Li-ion battery adds a significant cost to the system. Where autonomy is increased, the overall system cost increases too. The DG will operate as explained under the DC coupled systems above.

Schematic diagram to illustrate AC-DC Coupling topology

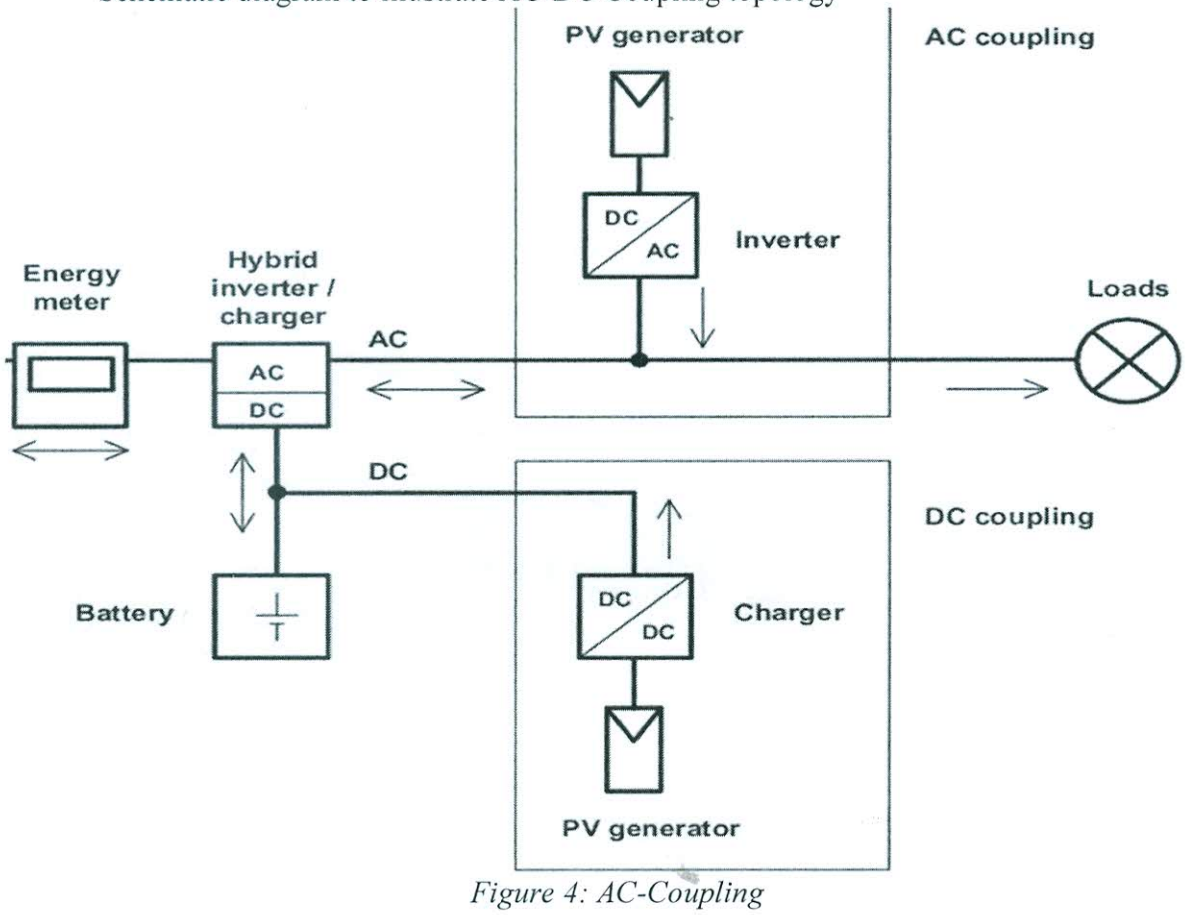

Figure 4: AC-Coupling

14.4 Design for cascaded shutdown

REF requires the photovoltaic mini-grid system to have multi-component to facilitate a gradual shutdown in case of component failure as opposed to a complete shutdown on the occasion of the failure of at least one component, i.e. a failure in one component should not cause the failure of the entire mini-grid system.

Therefore recommends that the system be designed as below:

- The system must have a multiple of inverters e.g. 20kW power module system. For example, if the mini-grid system to be designed requires a 60kW PV system, an ideal system will have 3 X 20kW PV system. This is only an example. A bidder with smaller sized inverters will provide for the sufficient number. Similarly, a bidder with bigger sized inverters will provide for the sufficient number.

- ESS module shall be built from blocks building up to the total required capacity. For example, if the mini-grid system to be designed requires a 180kWh ESS system, an ideal system will have 3X 60kWh DC storage.
- Whatever combination of components of one type chosen, the quantity of each component should be enough to build up to nominal mini-grid capacity. To that end a mini-grid of 120kW for example must be have sufficient number of solar panels, inverters and batteries appropriately configured to give the system total capacity of 120kW.

14.5 Design for Availability

The mini-grid system (PV, ESS and diesel generator) shall be designed and sized to provide power without service interruptions. At least 70% of the energy supplied to the loads shall be from renewable sources (PV + ESS) as opposed to the DG.

14.6 Design for Reliability

Mini-grid ESS shall be designed to last a minimum of 10 years. Mini-grid photovoltaic array shall be designed to last 25 years. REF requires a minimum full system warranty of one (1) year on mini-grid generation systems. This is to be differentiated from the warranty of each system component. This is meant to guarantee the functionality of the composite system built from components

Developers must validate system reliability by providing objective evidence that all system components are designed at least 10 years life-span. Developers are expected to provide all technical literature and design documents that validate the 10-year reliability claim of each component specified within the system.

Developers must demonstrate that the energy storage system is designed to last for the duration of 10 years under daily solar cycling conditions.

Developers shall assume that on average, half of the daily energy consumption will come from solar, and half will be drawn from energy storage.

Lead Acid batteries **DO NOT** meet our battery performance and environmental requirements and **SHALL NOT** be used for this application.

Only **Lithium Iron Phosphate (LiFePO4)** batteries with a rated cycle life of more than 4500 cycles @ 85% DOD from a credible and certified manufacturer shall be used for this project.

14.7 Design for Successful Transportation and Installation

Mini-grid ESS shall be designed to guarantee a 6-month shelf life i.e. life before installation.

Developers must provide information on system-powered-down energy consumption (battery self-discharge) the 6-month window will ensure that the mini-grid ESS is functional on arrival and installation, regardless of reasonable storage and transportation delays.

14.8 Design for Safe Disposal

Solar Photovoltaic mini-grids shall be designed for safe disposal. Developers may only use materials that are non-hazardous and non-toxic. Solar Mini-grid system must use lead free soldering and proof is to be provided.

14.9 Remote Monitoring System

Developers are required to ensure that the equipment is compatible with smart remote monitoring software system that will report on the operation of each mini-grid. The equipment shall conform to 3G/LTE remote monitoring system as a minimum and shall integrate with metering system that reports on power production, ESS state of charge, energy storage usage, diesel usage and overall system efficiency. The monitoring system shall also implement a smart Automatic diesel Generator Start Control system.

The remote monitoring system shall provide a web based (HTML 5, JAVA, etc....) that will display essential mini-grid power station information. Remote Monitoring System must be compatible with the Phase I equipment management that has now been established by REF.

14.10 Metering Systems

The mini-grid power generation system to be developed shall have proper bulk metering system at the generator as well as meters for individual loads. The schedule of customers shall be used to determine the number of individual meters required.

14.11 Standards and Certificates

Developers shall provide IEC-standard certificates for Solar Panels, Battery Cells, PV Inverters and Gen-sets from an accredited laboratory recognized by REF as duly advised by national statutory regulatory or industry policing bodies like SAZ, ZERA, World Research Council, etc. REF reserves the right to take samples for testing purposes before putting the systems in the field.

Each developer's proposal (technical capacity and product performance) will be measured using the below defined detailed technical requirements. It is very important that each bidding developer provides accurate and complete information as requested in the table. Developers that provide inaccurate, misleading or incomplete information will be disqualified.

15 DETAIL COMPONENT LEVEL REQUIREMENT

Developers shall follow the following specific guidelines in responding to each requirement stated in the table by indicating:

FC = Full Compliance
PC = Partial Compliance
NC = No Compliance

In the 'Remarks' section, developers must indicate how they fully comply, partially comply, or not comply with the stated requirements. Developers that only put FC, PC, or

NC but do not explain or show explicitly how they comply with the stated requirements will be considered NOT COMPLIANT.

Example:

Table 3: Detail Component Level Requirement Example

REQ_ID	Requirement	FC	PC	NC	Remarks
BAT-REQ1.	Battery cell shall have energy density greater than 110Wh/Kg.	Y			The selected LiFePO4 battery has energy density of 120Wh/Kg as stated on page xxx in the enclosed battery data sheet.

15.1 Solar Photovoltaic Panel and Mounting Structure Requirements

The solar panel and the solar panel structure must comply with the following requirements: The remarks column shall be used to either direct, indicate or demonstrate to REF the location of level of compliance status in the attached product literature. Where absolute figures are requested, they must be provided and validated on the brochures or such related product literature

Table 4: General requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Solar Photovoltaic Panel Requirements				
SOLAR-REQ1.	The solar photovoltaic panels cells shall be of mono-crystalline type				
SOLAR-REQ2.	Power output from a single photovoltaic panel shall be not less than 400Wp @ Standard Test Condition (STC).				
SOLAR-REQ3.	The photovoltaic panel efficiency shall not be lower than 20%.				
SOLAR-REQ4.	The photovoltaic panel surface shall be low iron tempered anti-reflection coating, and the thickness shall be at least 3mm.				
SOLAR-REQ5.	The power production of the photovoltaic modules warranted to retain a minimum of 80% of nameplate rating after 25 years of operation.				
SOLAR-REQ6.	The photovoltaic panels shall be installed in a series/parallel configuration as required to meet the proper voltage requirements.				

SOLAR-REQ7.	The developer shall use photovoltaic cells of a well-known and credible supplier to build the photovoltaic panels. The developer shall provide proof that the PV cells used to manufacture the solar panels are procured from a credible supplier and are field proven.				
SOLAR-REQ8.	The developer shall supply detailed specification and catalog of photovoltaic panel.				
SOLAR-REQ9.	The junction box for the photovoltaic array shall have a waterproof design and shall be easily wire-able at the deployment site. The water ingress protection shall be IP65 and proof must be provided and not implied.				
SOLAR-REQ10.	The photovoltaic panel frame shall be made from anodized aluminum alloy. Proof must be provided.				
SOLAR-REQ11.	The photovoltaic panel shall meet IEC 61215				
SOLAR-REQ12.	Developers shall provide a minimum of12-year warranty for solar panels for workmanship and manufacturing related defects.				
SOLAR-REQ13.	Developers shall provide a minimum of 20-year performance warranty to ensure that solar panels achieve 80% of nameplate rating after 20 years of operation.				
SOLAR-REQ14.	The PV array should have anti-theft feature, once the PV module is lost, system can give warning. Proof of anti-theft system is required.				
	Photovoltaic Array Structure Requirements				
SOLAR-REQ15.	The photovoltaic array structure shall be designed to support the proposed photovoltaic modules. Drawings demonstrating the sufficiency of the support must be provided.				

SOLAR-REQ16.	The photovoltaic module shall be mounted on a frame fixed on the supporting poles and these poles will be fixed on the concrete plinths, the front supporting poles height can be chosen from 1.5m from the front side and can be used @15^0				
SOLAR-REQ17.	Exposed photovoltaic structures, the all in one cabinet housing inverters and batteries and the distribution network must be protected by an external and internal lightning protection system according to IEC 62305 – depending on the requirements of the region related to potential risk of lightning strikes. Lightning protection level (LPL) should be II or III. Other mandatory standards to be fulfilled are IEC 62446 and IEC 60364. Proof of compliance is required.				
SOLAR-REQ18.	The manufacturer of photovoltaic structure shall have ISO9001 and other relevant manufacturing process certifications. Copies of certificates to be provided.				
SOLAR-REQ19.	The installation bolts of photovoltaic panels and junction boxes shall be designed to secure the system properly. Side and end elevation drawings of the support structure are required.				
SOLAR-REQ20.	The photovoltaic array shall be capable of resisting wind speed of 160 km/h and the structure shall have required appropriate features to withstand storms. Drawings showing the supporting mechanisms are required.				
SOLAR-REQ21.	Dip angle of photovoltaic structure shall be proposed according to the installation latitude coordinates, and the developer shall provide detail design of the dip angle.				
SOLAR-REQ22.	The photovoltaic structure shall be designed to provide proper electrical grounding. Drawings or other proof must be provided.				
SOLAR-REQ23.	The photovoltaic structure shall be designed				

	to provide lightning protections.				
SOLAR-REQ24.	All steel parts and the accessories of any steel structure have to be hot dip galvanized. The hot dip galvanizing shall be executed in accordance with ISO 1461. All tubular bars must be galvanized from inside and outside. Minimum thickness of the zinc coat is 40µm. Proof to be provided.				
SOLAR-REQ25.	Design standards: ASCE 7-05, ANSI/TIA-222-G				

REF staff or a third party may visit photovoltaic panel manufacturer to confirm:

- Photovoltaic cell sourcing (bidders must provide photovoltaic cell manufacturer name and evidence or receipt of procurement of photovoltaic cells from such vendor)
- Photovoltaic panel manufacturing process
- Manufacturing capacity
- Manufacturing quality assurance process
- Overall credibility and facility certifications

REF staff may visit photovoltaic structure manufacturer facility to ensure proper sourcing, manufacturing, and quality assurance processes are meet.

15.2 Power Conversion System Requirements

DC Coupled Systems

The Power Conversion System must comply with the following requirements:

Table 5: Mini- grid inverter system

REQ_ID	Requirement	FC	PC	NC	Remarks
	Mini- grid inverter system				
CRTL-REQ1.	Support multi-peak and global MPPT technology, harvest more energy.				
CRTL-REQ2.	The PV input voltage range is ≥250				
CRTL-REQ3.	The full load MPPT voltage range is ≥500				
CRTL-REQ4.	The MPPT tracking precision shall be at least 99%.				
CRTL-REQ5.	All-in-one design cabinet (PV input/Battery input/D.G input/AC output), it is easy deployment.				
CRTL-REQ6.	The power cabinet adopts modular design, which is composed of several hot-swappable modules, including monitor module, power module, diesel access module, it is easy expansion and maintenance, save the customer's investment.				

CRTL-REQ7.	For the cabinet level expansion, the power cabinets can be connected in parallel.				
CRTL-REQ8.	Support Self-awaken function even battery is empty and just only solar energy.				
CRTL-REQ9.	Support 100% load unbalance output function， one or two-phase full load output (other phase no-load).				
CRTL-REQ10.	Support smart scheduling for solar/diesel/battery energy, optimize use the solar energy, control D.G. (send out on/off signal) when capacity of battery reach DOD automatically.				
CRTL-REQ11.	Support centralized management of network management system, regular self-check remind, one-touch remote patrol report.				
CRTL-REQ12.	Provide PV/Battery input reverse connection protection, over voltage/current protection.				
CRTL-REQ13.	Provide AC output short circuit protection, over voltage/current protection.				
CRTL-REQ14.	MTBF of inverter module is not less than 105-120 hours				
CRTL-REQ15.	The Operating temperature range is up to +55°C.				
CRTL-REQ16.	The Relative humidity is 5~95% RH (non-condensing).				
CRTL-REQ17.	The Cooling mode is intelligent forced air cooling.				
CRTL-REQ18.	The Maximum altitude is 4000 m (de-rated when the altitude is greater than 2000 m.				
CRTL-REQ19.	Support liquid crystal display (LCD) touch screen or any digital display.				
CRTL-REQ20.	Over load protect is not less than 60min@110%,10min@125%, 1min@150%.				
CRTL-REQ21.	The Communication should include RS485 or CAN				
CRTL-REQ22.	Rated output voltage is 380V/400V/415V optional, 3/N/PE.				
CRTL-REQ23.	Rated output frequency is 50Hz.				
CRTL-REQ24.	Default AC output Voltage (off-grid) is 400V±10%.				
CRTL-REQ25.	Default AC output frequency (off-grid) is 50 Hz ± 0.25%.				
CRTL-REQ26.	Total harmonic distortion (THD) is less than 3% (at rated power).				
CRTL-REQ27.	Can be adapted to 100% unbalanced load.				
CRTL-REQ28.	The system shall be a DC coupled system				
CRTL-REQ29.	The system supports automatic startup and				

	shutdown of the D.G. When the battery discharge depth is 85%, the D.G. automatically starts. When the solar intensity is sufficient to supply power to loads, the D.G. stops running.				
CRTL-REQ30.	The emergency stop button should be clearly placed on the front of the cabinet to protect personnel safety, The buttons shall be designed with protection against maloperation.				
CRTL-REQ31.	The system output has an isolation transformer and supports level-A surge protection.				
CRTL-REQ32	The system supports the fuel level sensor and remotely monitors the fuel level.				

Developers must provide required certification documents when bid is submitted. REF staff will authenticate certification documents.
REF staff or contracted third party will visit inverter manufacturer of selected bidders. Bidders must provide inverter supplier information when they submit the bid.

AC Coupled System

Table 6: Requirements for AC-Coupled System

REQ_ID	Requirement	FC	PC	NC	Remarks
	PV/Grid Tie Inverter				
CRTL-REQ1.	Maximum PV Generator power should be ≥50KW				
CRTL-REQ2.	Maximum input voltage- 1000VDC/1500VDC				
CRTL-REQ3.	Number of independent MPPT inputs -6				
CRTL-REQ4.	Number of strings per MPPT input-2				
CRTL-REQ5.	Maximum efficiency > 97%.				
CRTL-REQ6.	The type of inverter should be a scalable Grid Tie Inverter				
CRTL-REQ7.	The rated AC output power - 50000W (230V,50Hz)				
CRTL-REQ8.	Maximum Apparent AC power -50000VA				
CRTL-REQ9.	Number of PV inverter units required-3 Total inverter capacity-150KW (3X50KW)				
CRTL-REQ10.	AC Nominal Voltage-230V/400V				
CRTL-REQ11.	Output frequency-50Hz				
CRTL-REQ12.	Output phases-3				
CRTL-REQ13.	Provide PV/Battery input reverse connection protection, over voltage/current protection.				
CRTL-REQ14.	Provide AC output short circuit protection, over voltage/current protection.				
CRTL-REQ15.	Interface -Ethernet / WLAN / RS485				

CRTL-REQ16.	The Operating temperature range is -25°C +60°C.				
CRTL-REQ17.	Max. permissible value for relative humidity (non-condensing) is 100%				
CRTL-REQ18.	The Cooling Concept- Active cooling system/Opt cool				
CRTL-REQ19.	Protection Degree-IP65				
CRTL-REQ20.	Total harmonic distortion (THD) is less than 3% (at rated power).				
CRTL-REQ21.	LED indicators (status / fault / communication				
CRTL-REQ22.	The system shall be a AC coupled system				
CRTL-REQ23.	The system should support automatic startup and shutdown of the D.G. according to set battery depth of discharge.				
CRTL-REQ24.	Standards IEC 61727, IEC 62109-1/2, IEC 62116, IEC 60068-2-x				
CRTL-REQ25.	The system output has an isolation transformer which is rated at ≥150KVA				
CRTL-RE26.	Test Certificates should be provided				
	Battery Based Inverter (BBI)				
CRTL-REQ1.	Rated power ≥6000W				
CRTL-REQ2.	DC input Voltage≥ 48VDC				
CRTL-REQ3.	Maximum efficiency>95%				
CRTL-REQ4.	Rated Voltage 230V/400V. Where single-phase inverters are used, the inverters should be configured to a 3-phase output.				
CRTL-REQ5.	Output frequency 50 Hz				
CRTL-REQ6.	Total Harmonic distortion is <1.5%				
CRTL-REQ7.	Battery type: Li-ion				
CRTL-REQ8.	Communication with GTI inverter for power output is through Frequency Shift Power Control				
CRTL-REQ9.	Total capacity of BBI≥126KW. Note some solutions require a ratio of 1:1 between the PV inverter and BB1 and the bidder is required to adhere to manufacture's recommendation. The bidder should not change the PV array size and the PV inverter capacity, where the BBI recommended can match the PV inverter size.				
CRTL-REQ10.	Protection Degree-IP54				
CRTL-REQ11.	AC short-circuit / AC overload				
CRTL-REQ12.	Over temperature / battery deep discharge				
CRTL-REQ13.	Operating temperature range -25◦C to 60◦C				
CRTL-REQ14.	Standards IEC 62116, IEC 61727, IEC 62109-1/-2,				

CRTL-REQ14.	Test certificates should be provided				

15.3 Lithium Battery System Requirements

The lithium battery System must comply with the following requirements:

Table 7: Lithium battery requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Lithium Battery Cell Specifications				
BAT-REQ1.	Positive electrode Material: Lithium Iron Phosphate (LiFePO4), not less than 4500cycles @85% DOD, 35℃.				
BAT-REQ2.	The DC voltage range is 350~750V.				
BAT-REQ3.	The rated DC voltage is 400~650V.				
BAT-REQ4.	The Maximum charge current is 2C; Battery supports continuous 1C charging and discharging (full charge within one hour), provides test reports.				
BAT-REQ5.	Controller should support the battery management for charging and discharging, support a variety of charge and discharge mode， such as constant voltage charging, constant current charging				
BAT-REQ6.	Comply with UN38.3 standards, CE standards (IEC 62619, IEC 62477-1)				
BAT-REQ7.	High charge/discharge efficiency, up to 96% (prediction), save more energy loss;				
BAT-REQ8.	Cabinet and Modular design, support cabinets in parallel;				
BAT-REQ9.	Support battery self-balance, new and old battery mixed supported; To meet future battery capacity expansion requirements, batteries must support mixed use of new and old lithium batteries. When the new and old batteries are used together, there should be no battery voltage difference between new and old. There is no mutual discharge between the old and new batteries.				
BAT-REQ10.	The energy storage system shall use air conditioner cooling;				
BAT-REQ11.	There shall be an embed battery management unit (BMS) to manage the health of the battery, and communicate monitoring center with the real-time status;				
BAT-REQ12.	When the new battery replaces the faulty battery, there is no need to pre-adjust the battery capacity, and there is no energy loss during the capacity balancing process between modules;				

BAT-REQ13.	Voltage, current, temperature sampling and protection of the battery/module, using independent dual systems, sampling mutual verification, protection mutual backup;				
BAT-REQ14.	The battery cabinet has active switching function. When the battery cabinet fails, the faulty cabinet is automatically isolated. After the fault is eliminated, the cabinet can actively access the system at a proper time;				

Other battery types are not acceptable for this project. Bidders that do not meet this requirement shall be automatically disqualified.
REF staff will visit battery manufacturer of selected bidders. Bidders must provide battery supplier information when they submit the bid.
Developers shall provide all listed certifications from corresponding certifying agencies. REF staff will verify all certifications submitted by bidding suppliers.

15.4 Diesel Generator Requirement

The Diesel Generator must comply with the following requirements:

Table 8a: Generator set requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Diesel Generator Specification				
INV-REQ1.	The diesel generator shall have three-phase 230/400VAC output.				
INV-REQ2.	The diesel generator shall have auto start function commanded by external signal and must be integrated into the system controls.				
INV-REQ3.	The diesel generator shall have continuous prime power rating as stated in the bid document for each site (+/- 15%) @ 50Hz, 30°C ambient temperature and 0.8 power factor.				
INV-REQ4.	The diesel generator shall have minimum fuel efficiency of 32% in real operation on site. Proof is required.				
INV-REQ5.	The diesel generator shall have maximum noise emission level of 85dBA. Bidder to indicate absolute value for the generators being proposed.				

REF staff or contracted third party will verify each compliance claim during supplier site visits and again during the commissioning and training phase of the project.

15.5 Diesel Generator Tank Requirement

The Diesel Generator Tank must comply with the following requirements:

Table 8b: Generator set tank requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Diesel Generator Tank Specification				
INV-REQ6.	The diesel generator tank shall have double walled tank made of steel.				
INV-REQ7.	The diesel generator tank shall have suction tube inserted from top of the tank with needed capacity for each pilot site.				
INV-REQ8.	The diesel generator tank shall have high quality fuel pipes connected from Genset to tank without using small tank of the Genset.				
INV-REQ9.	The diesel generator tank shall have large funnel and fuel filter for refueling.				
INV-REQ10.	The diesel generator tank shall have an option to connect a second generator in parallel without a need to modify the tank or empty the tank.				
INV-REQ11.	Developers shall provide detailed schematics of how the diesel generator and the tank are to be connected and operated.				
INV-REQ12.	The diesel generator tank shall have integrated dewatering valve.				
INV-REQ13.	The diesel generator tank inlet and all openings shall be lockable with padlock(s)				
INV-REQ14.	The diesel generator tank pipes shall be made of steel tubes and shall not be removable without tools.				
INV-REQ15.	The diesel generator tank shall have a cage made of steel around the pipes to prevent manipulation of the pipes.				
INV-REQ16.	Developers shall guarantee a safe and reliable operation of the diesel generator and its tank during commissioning and operation.				

REF staff will verify each compliance claim during supplier site visits and again during the commissioning and training phase of the project.

15.6 System cabinet & shelter requirements

The system shelter shall provide enclosure for the Energy Storage System (ESS) and the power conversion system. The shelter must comply with the following requirements:

Table 9: System cabinet &shelter Specifications

REQ_ID	Requirement	FC	PC	NC	Remarks
	System cabinet &shelter Specifications				
ENC-REQ1.	The cabinet shall have properly sized and secure PV input interfaces and connectors.				
ENC-REQ2.	The shelter shall be designed to be water, dust and insect/rodent resistant, IP65				
ENC-REQ3.	The shelter shall be made of a material that is resistant to rapid temperature changes, shocks, UV, corrosion, chemical agents and pollution. Proof required.				
ENC-REQ4.	The shelter enclosure shall have a minimum climatic cycle range of -20 ° C to +55° C				
ENC-REQ5.	The material used to build the cabinet shall be corrosion free and it should be acid resistant. Name of the material required.				
ENC-REQ6.	The shelter shall be considered in anti- thief design. Describe the anti-theft mechanism				
ENC-REQ7.	The shelter shall have a passive or active cooling system. Suppliers shall state the power consumption of the cooling system in case of active cooling system.				
ENC-REQ8.	For the AC Coupled system, a container made from metal sheets is required and the container should have an active cooling system.				

REF staff or contracted third party will verify each compliance claim during supplier site visits and again during the commissioning and training phase of the project.

15.7 Remote Monitoring System Requirements

The power management, monitoring system shall comply with the following requirements:

Table 10: Remote Monitoring System Specification

REQ_ID	Requirement	FC	PC	NC	Remarks
	Remote Monitoring System Specification				
MGT-REQ-1.	The Vendor shall have previously, commercially demonstrated the capacity to design and build a				

REQ_ID	Requirement	FC	PC	NC	Remarks
	centralized monitoring and control system for systems similar to what is required here in.				
MGT-REQ-2.	The Vendor shall clearly indicate all interfaces, standards and protocols provided/required by the centralized monitoring and control system.				
MGT-REQ-3.	The Vendor shall clearly indicate all specifications, control features and alarm/event logging provided by the centralized monitoring and control system				
MGT-REQ-4.	The monitoring system shall have data logging and storage capabilities in either local or global cloud storage.				
MGT-REQ-5.	The monitoring system shall support secure individual user access, remote user access management (Administration), fault tracking, alerts and all security information using visual display.				
MGT-REQ-6.	Basic Functions: clock synchronization and time zone management; disk redundancy backup; data backup and restore; monitoring system self-diagnosis; customized homepages; one-touch search.				
MGT-REQ-7.	Alarm Mgmt.: Alarm collection and storage; alarm processing; alarm setting; customized dry contact alarm management; alarm masking and alarm thresholds setting; alarm troubleshooting expert advice and closed-loop maintenance experience base. Provide screenshots to prove this entry.				
MGT-REQ-8.	Configuration Management: Site controller discovery, batch sites copy and batch parameters modification, configuration data export to EXCEL. Provide screenshots to prove this entry.				
MGT-REQ-9.	Performance and Report: Historical data collection, query, statistical analysis; Day/Week/Month/Year report management; customized report; automatic periodic report; energy network KPI report. Report export: CSV, PDF, EXCEL files, printer or email. Provide				

REQ_ID	Requirement	FC	PC	NC	Remarks
CABLE3.	Positive (+) and Negative (-) terminals for DC power cables and bus-bars shall have matched diameters.				
CABLE4.	All load cables shall be tagged and labeled properly with appropriate load power, electrical voltage, electrical current and electrical frequency; tags and labels shall be easily recognizable.				
CABLE5.	All cables, bus-bars and current carrying conductors shall be de-rated and sized to meet the National Electric Code (NEC) cable and wire sizing codes. Vendors shall provide a detailed design document indicating electrical power requirements and associated cables sizes.				
CABLE6.	All cable and bus-bar layouts shall be specifically designed to meet NEC standards.				
CABLE7.	All buried cables shall be extended in a PVC pipe of suitable diameter and buried at least 0.3m depth for protection against rodents and physical damage.				
CABLE8.	All indoor and outdoor cables shall be extended in a suitable cable tray that is manufactured from galvanized steel sheets of 1-mm thickness and it shall have all necessary accessories.				
CABLE9.	The conductor material of cable core must be copper				

REF staff will review detailed power requirements of each cable, derating and sizing of cable per NEC code.

15.9 Pre-pay meter system Requirements

The prepay meter system shall comply with the following requirements:

Table 12: Pre-payment meter

REQ_ID	Requirement	FC	PC	NC	Remarks
	Pre-pay meter				
SPR-PRT1.	The prepay meter need meet the follow standard: IEC62052-11 Electricity metering equipment(AC)-General requirements, tests and test conditions- Part11:Metering equipment IEC62053-21 Electricity metering				

	equipment(AC)-Particular requirements-Part21:Static meters for active energy(classes 1 and 2) IEC62055-31 Electricity metering -Payment systems-Part31:Particular requirements Static payment meters for active energy(class 1 and 2) IEC62055-41 Electricity metering-Payment systems-Part 41:Standard transfer specification (STS) - Application layer protocol for one - way token carrier systems IEC62055-51 Electricity metering -Payment systems-Part51:Standard transfer specification(STS)-Physical layer protocol for one-way numeric and magnetic card token carriers IEC 62056-21 Electricity metering – Data exchange for meter reading, tariff and load control –Part 21: Direct local data exchange IEC 62056-42 Electricity metering – Data exchange for meter reading, tariff and load control – Part 42: Physical layer services and procedures for connection oriented asynchronous data exchange IEC 62056-46 Electricity metering – Data exchange for meter reading, tariff and load control – Part 46 – Data link layer using HDLC-protocol IEC 62056-53 Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM Application layer IEC 62056-61 Electricity metering - Data exchange for meter reading, tariff and load control - Part 61: Object identification system IEC 62056-62 Electricity metering - Data exchange for meter reading, tariff and load control –Part 62: Interface classes				
SPR-PRT2.	**The single phase prepay meter main specification:** Wire Type: 1- Phase, 2-Wire (Direct connection) Tariff Structure: Single Rate Communication Interface 1 : Near Infrared Interface 2 : RS485 Model Of Meter: 220V 5(60) A Installation: Outdoor Installation(With meter box) Measurement: Single Measuring elements				

	Rated Voltage(Un):220V Variation Of Voltage:60%~120%Un Limit Range Of Operating Voltage:0Un～1.90Un Frequency:50Hz Frequency Application Range:47.5 Hz～52.5 Hz Number Of Terminal:4 Accuracy Class:1.0(Reference to IEC standard) Common Current Specification;5（60）A Imax: 60A Meter Starting Current:0.4%Ib Meter Metering Current Range:20mA ~ 60A Power Consumption Of Voltage Circuit:≤2W/10VA Power Consumption Of Current Circuit:≤4VA Meter Constant:1600 imp/ kWh or other Display: LCD Display No. Of Digits For Credit Storage:6+2 Display Language: English Calendar Time: Local Time Level Of Protection: IP54 Line Type: LNNL Line Drawing: Laser Printing in terminal cover Sealing:Sealing screw for modular box and terminal cover Packing list: Include Specification Meter Number Certification Lifetime (Minimum):15 year Except battery which is 10 years Latch Relay Pole: one ,80A, UC1 Keypad:12-key keypad Energy balance for out port factory:100 kWh Load threshold:60A				
SPR-PRT3.	**The single phase prepay meter main specification:** Wire Type:3- Phase, 4-Wire (Direct Connected type) Tariff Structure:Single Rate				

	CommunicationInterface 1 : Near Infrared Interface 2 : RS485 Model Of Meter:3*220/380 Volt 5(60) A Installation:Indoor Installation(Installation in meter box, support for outdoor installation) Measurement:3 Circuits Metering (including neutral circuit metering) Rated Voltage(Un):3*220/380V Variation Of Voltage :60%~120%Un Limit Range Of Operating Voltage: 0Un～1.90Un Frequency: 50Hz Frequency Application Range:47.5Hz～52.5 Hz Accuracy ClassActive accuracy: Class 1.0(IEC 62053-21) Reactive accuracy: Class 2.0 (IEC 62053-23) Common Current Specification: 5(60)A Imax:60A Meter Starting Current:0.4%Ib Meter Metering Current Range:20mA ~ 60A Power Consumption Of Voltage Circuit: ≤2W/10VA Power Consumption Of Current Circuit:≤4VA Meter Constant:800 imp/ kWh or other 800 imp/ kVarh or other Display:LCD Display No. Of Digits For Credit Storage:6+2 Display Language:English Calendar Time:Local Time Level Of Protection:IP54 Line Type :AABBCCNN Line Drawing:Laser Printing in end cover Sealing:Sealing Packing list:Include Specification、Meter Number、Certification Service Life (Minimum):15year battery is :10 years, Display Button1				

	Latch RelayPole: Three , 80A, UC1 External Battery(Super Capacitor) Cover/Terminal cover open Tamper must be detected with and without mains power connections, Replaceable Keypad:Have Keypad Keypad:12-key keypad Energy balance for out port factory:100 kWh Load threshold:60A				

15.10 Spare Part Requirements

Spare parts for the system shall comply with the following requirements:

Table 13: Spare Part Requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Spare Part Requirements				
SPR-PRT4.	The selected developer has an obligation to notify REF 12 months prior to product obsolescence, product production halt or end of service.				
SPR-PRT5.	The selected developer has an obligation to notify REF when upgradable software and hardware will be available.				

15.11 Warranty Requirements

Selected suppliers shall comply with the following warranty requirements:

Table 14: Warranty Requirements

REQ_ID	Requirement	FC	PC	NC	Remarks
	Warranty Requirements				
WRTY-1	The developer shall provide at least one (1) years of FULL system warranty including battery module.				
WRTY-2	The developer shall provide 24 hours of technical support either online, by phone or physically at the project site in the English language for the duration the pilot trial of 6 months. Any one of the above methods is acceptable. REF shall levy appropriate penalty on developers that do not meet this criterion per stated liquidated damages clause.				

15.12Technical Documents to be submitted to REF

Selected suppliers shall submit the following technical documents:

Table 15: Technical Documents to be submitted

REQ_ID	Requirement	FC	PC	NC	Remarks
	Technical Documents to be Submitted				
DOC-1.	Product Data: Submit manufacturer's product data for each system proposed for use. Include the following: 1. Signal and operating fixtures, operating panels and indicators. 2. Solar array dimensions and layout. 3. Junction box details (if necessary) 4. Charge controller or Solar Inverter electrical characteristics, interface requirements and other relevant technical documents needed for evaluation. 5. Battery cell details 6. Battery module details 7. Inverter details 8. Expected heat dissipation of the inverter (KW or BTU). 9. Details of cables and busbars used in the entire system. 10. The entire system detail civil work design shall be provided. (design of Solar Array System, ESS and Inverter Module)				
DOC-2.	Shop Drawings: Submit approval layout drawings. Include the following: 1. Panel sizes and drawings. 2. Solar array layout diagram. 3. Electrical connection diagrams. 4. ESS module assembly diagram				
DOC-3.	Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.				

REF will consider incomplete or inadequate technical documentation as non-compliance.

16 VALIDATION AND VERIFICATION

16.1 Component/Subsystem Level Validation and Verification

Developers must provide component/subsystem level performance test report for each component selected in the system. Test report must validate stated performance specification of each component/subsystem. Component/subsystem level test reports are required on the following components as applicable:

- Solar array power performance and efficiency testing
- Charge controller efficiency testing
- Battery cycling and performance testing
- Inverter efficiency and performance testing
- Electrical safety testing of each component/subsystem

REF will verify test reports via third party test facilities and/or retesting of any of the components specified if necessary. Developers that provide inaccurate and false test reports shall be fined and/or disqualified immediately.

16.2System Level Testing

Developers must issue system level test reports that provides details on:

- Daily average solar production
- Battery capacity test report
- Daily Peak Solar Production
- Overall system efficiency (from solar panel to power distribution output)
- Overall solar system standby power
- Detailed System electrical failsafe mechanisms and associated test reports

REF will verify test reports via third party test facilities and/or retesting of any of the attributes specified. Developers that provide inaccurate and false test reports shall be disqualified.

17PRODUCTS AND SERVICE SUPPLY SCOPE

The bidder is required to supply the following products for the respective mini-grids

Table 16: Products and Services Supply Scope:

No	Component	Parameter	Required Value
1		USER Manual submission	specification manual of Equipment
			Installation and maintenance
		Documents list	Original brochures or catalogue including the datasheet of all components
			Detailed Single line diagram of the solar system Electrical connection/wiring drawings Showing connections of components Solar array, Hybrid inverter, battery, Load output isolating and protection points.
			Bill of Material to include sizes and numbers of components to be deployed *(Solar array, Battery Bank and Inverter Cabinets should not be omitted)*

			Solar array layout description and drawings of the structures (plan, end elevation and side elevation a0 are required i.e. string connections and number of strings
			Energy Storage Module Assembly description I. Series and parallel connections *II.* String connections
			Inverter module assembly description I. No of inverters II. Size of inverters III. Connection line diagram *IV.* Inverter inputs and outputs
2	Hybrid inverter (cabinet)	Nominal AC output Voltage	400Vac Three-phase, Supplied on distribution network
		Battery Voltage	≥48VDC
3	Lithium battery	Battery capacity	As per site specification
		Lithium battery module	≥4.8KWH, LFP
		Nominal Battery Bank Voltage	≥48VDC
4	Perimeter Fencing Solar Generator	Palisade Spiked top, rust protected Fencing	Height ≥2.2m from the ground

17.1 Site 1: HWAKWATA-CHIPINGE DISTRCT, MANICALAND PROVINCE:

Site Location:
https://www.google.com/maps/d/edit?mid=1R3ivY0fe5a9RByxMfWSkyT2WOpcI3jrv&ll=-20.824533907341056%2C32.457606483760216&z=15

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Customer Schedule

Table 17.1a – Customer Schedule for Hwakwata

No.	loads type	number	Connection type
1	Village Households	50	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	9	Single phase
3	Business Centre shops	13	Single phase
5	Clinic	1	Single phase
5	Clinic House Holds	4	Single phase
10	Productive loads	2	3 phase
11	Bulk Metering	1	3 phase

Area of Solar PV generator: 6000 m2

Bill of Quantities:

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design

Table 17.1b – Bill of Quantities for Hwakwata

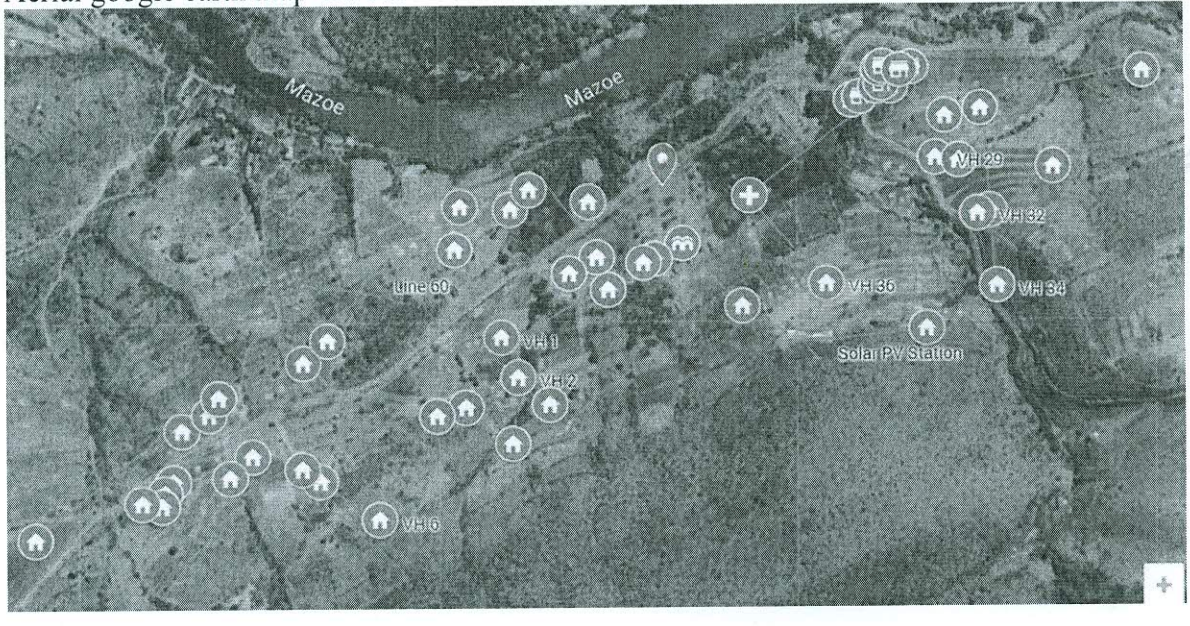
No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400Wp	pcs	
		PV module Capacity	≥135kw		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out， IP65	pcs	
		PV extension cable	4mm²， from PV module to combiner box， As per requirement	lot	
		Cables	16mm²， from combiner box to inverter ， as per requirement	lot	
		Embedded parts package	As per requirement	lot	
2	Micro grid Inverter system	Micro-grid inverter	120kW, 400V 50Hz, 3P output	pcs	
		Isolation Transformer	120 kVA	pcs	
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery cabinet	552.0 kWh,	pcs	
		Power cables	Electric Cable,600V, 168A,UL， Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANTONE 430U	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	50 kVA (60% of Peak Load)	pcs	0
		Cables	from DG to inverter	lot	
		Communication cable	Dry contact， 2*1mm²	lot	
5	Distribution system	Lightning protection grounding grid	135 KW Lightning Protection Grounding Grid, for Grounding Package	set	
		pole earthing	Solution of Electric Power-Overhead line first pole earthing	pcs	

		Site accessories	135 KW Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Vending Client Software	Vending Client Software	set	
		prepay meter	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepay meter	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
		Single-phase Meter (one meter)	Equipment Box,80000mA,English,One epitope single phase energy meter box, wall /pole mounting	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 6000m^2	m	

17.2Site 2: CHIWORE (UMP-MASHONALAND EAST PROVINCE)

Site Location:
https://www.google.com/maps/d/edit?hl=en&mid=10Qrjd75nYELS7xyoaFalcFf1vt73A0pP&ll=-17.203374829166073%2C31.752816049999993&z=16

Aerial google earth map cut-out



Customer Schedule

Table 17.2a – Customer Schedule for Chiwore

No.	loads type	Number	Connection type
1	village Households	38	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	12	Single phase
3	Business Centre shops	15	Single phase
10	Productive loads	2	3 phase
11	Bulk Metering	1	3 phase

Area of Solar PV Generator: 2000 m2

Bill of Quantities

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design

Table 17.2b – Bill of Quantities for Chiwore

No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400Wp	pcs	
		PV Module Capacity	≥		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out， IP65	pcs	
		PV extension cable	4mm²， from PV module to combiner box， As per requirement	lot	
		Cables	16mm²， from combiner box to inverter ， as per requirement	lot	
		Embedded parts package	As per requirement	lot	
2	Micro grid Inverter system	Micro-grid inverter	60 kW, 400V 50Hz, 3P output	pcs	
		Isolation Transformer	60 kVA	pcs	
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery cabinet	Battery capacity 165.6 KWh,	pcs	
		Power cables	Electric Cable,600V, 168A,UL， Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANT ONE 430U	lot	

		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	25 KVA (60% of peak load)	pcs	
		Cables	from DG to inverter	lot	
		Communicatio n cable	Dry contact，2*1mm²	lot	
5	Distributio n system	Lightning protection grounding grid	60KW Lightning Protection Grounding Grid, for Grounding Package	set	
		pole earthing	Solution of Electric Power-Overhead line first pole earthing	pcs	
		Site accessories	60KW Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Vending Client Software	Vending Client Software	set	
		prepay meter	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepay meter	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
		Single-phase Meter (one meter)	Equipment Box,80000mA,English,One epitope single phase energy meter box, wall /pole mounting	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 2000m^2	m	

17.3Site 3: CHIWENGA-MUZARANABI MASHONALAND CENTRAL

Site Location:
https://www.google.com/maps/@16.1065835,31.3314449,327m/data=!3m1!1e3

Aerial google earth map cut-out


H18
Pry Sch Households
Gen 2 @ Sch
Gen 2 @ Sch
Chiwenga Pry Sch
H46
H44
H11
H20
H19
H45
H12
H9
H7
H10
H22
H21
H8
H23
H6
H5
H13
H14
H15
H4
H2
H3
Imagery Date: 11/7/2010


H32
H24
H31
H34
H33
H36
H37
Gen 1 @ Clininc
H39
H42
H27
Chiwenga Clinic
H43
H30
H28
H29
H26
H40
H41
Image © 2021 Maxar Technologies
Imagery Date: 11/7/2010

Customer Schedule

Table 17.3a – Customer Schedule for Chiwenga

No.	Customer type	number	Connection type
1	Village Households	35	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	6	Single phase
3	Business Centre shop	5	Single phase
4	Secondary School	1	Single phase
4	Secondary School House holds	4	Single phase
5	Clinic	1	Single phase
5	Clinic House Holds	3	Single phase
6	Churches	0	Single phase
8	VET & AREX OFFICES	0	Single phase
9	VET & AREX Staff Houses	0	Single phase
10	DDF workshop	0	Single phase
11	DDF households	0	Single phase
12	Priest House	0	Single phase
11	Productive loads (grinding mill and water pump)	1	3 phase
11	Bulk Metering	1	3 phase

Bill of Quantities

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design

Table 17.3b – Bill of Quantities for Chiwenga

No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400 Wp	pcs	
		PV module Capacity	≥15kw + ≥30kw		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out , IP65	pcs	
		PV extension cable	4mm², from PV module to combiner box, As per requirement	lot	
		Cables	16mm², from combiner box to inverter , as per requirement	lot	
		Embedded parts package	As per requirement	lot	
2	Micro grid Inverter system	Micro-grid inverter	1 X 30kW, 400V 50Hz, 3P output and 1 X 20kW, 400V 50Hz, 3Phase output	pcs	
		Isolation	1 X 20kVA	pcs	

		Transformer	1 X 30kVA		
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery cabinet	Partitioned for the two sections Gross capacity of 165.6kWh	pcs	
		Power cables	Electric Cable,600V, 168A,UL， Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANTONE 430U	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	1X 5kVA, and 1 X 10Kva	pcs	
		Cables	from DG to inverter	lot	
		Communication cable	Dry contact， 2*1mm²	lot	
5	Distribution system	Lightning protection grounding grid	Lightning Protection Grounding Grid, for Grounding Package	set	
		pole earthing	Solution of Electric Power-Overhead line first pole earthing	pcs	
		Site accessories	Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Vending Client Software	Vending Client Software	set	
		prepay meter	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepay meter	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
		Single-phase Meter (one meter)	Equipment Box,80000mA,English,One epitope single phase energy meter box, wall /pole mounting	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 1600m2	m	

17.4Site 4: DETE-HURUNGWE DISTRICT, MASHONALAND WEST

Site Location:
https://www.google.com/maps/@-16.4998087,29.9429763,592m/data=!3m1!1e3

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Customer Schedule

Table 17.4a – Customer Schedule for Dete

No.	Customer type	number	Connection type
1	village Households	26	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	15	Single phase
3	Business Centre shop	22	Single phase
4	Secondary School	1	Single phase
4	Secondary School House holds	8	Single phase
5	Clinic	1	Single phase
5	Clinic House Holds	3	Single phase
6	Churches	2	Single phase
8	VET & AREX OFFICES	0	Single phase
9	VET & AREX Staff Houses	0	Single phase
10	DDF workshop	0	Single phase

11	DDF households	0	Single phase
12	Priest House	1	Single phase
11	Productive loads (grinding mill and welding)	2	3 phase
11	Bulk Metering	1	3 phase

Bill of Quantities

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design.

Table 17.4b – Bill of Quantities for Dete

No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400 Wp	pcs	
		PV System Size	≥120kw		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out， IP65	pcs	
		PV extension cable	4mm²， from PV module to combiner box， As per requirement	lot	
		Cables	16mm²， from combiner box to inverter， as per requirement	lot	
		Embedded parts package	As per requirement	lot	
	Micro grid Inverter system	Micro-grid inverter	90kW, 400V 50Hz, 3P output and	pcs	
		Isolation Transformer	120kVA	pcs	
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery cabinet	Gross capacity 496.80kWh	pcs	
		Power cables	Electric Cable,600V, 168A,UL， Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANT ONE 430U	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	1X 20kVA	pcs	
		Cables	from DG to inverter	lot	
		Communication cable	Dry contact，2*1mm²	lot	

5	Distribution system	Lightning protection grounding grid	Lightning Protection Grounding Grid, for Grounding Package	set	
		pole earthing	Solution of Electric Power-Overhead line first pole earthing	pcs	
		Site accessories	Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Veding Client Software	Veding Client Software	set	
		prepay meter	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepay meter	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
		Single-phase Meter (one meter)	Equipment Box,80000mA,English,One epitope single phase energy meter box, wall /pole mounting	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 5000m^2	m	

17.5 Site 5: SOTI-SOURCE-GUTU DISTRICT, MASVINGO PROVINCE

Site Location:
https://www.google.com/maps/d/edit?hl=en&mid=15pt3B9PGy8V2bFb_5L2rkEVoOITA3NNw&ll=-19.45004051143446%2C31.20827160981893&z=19

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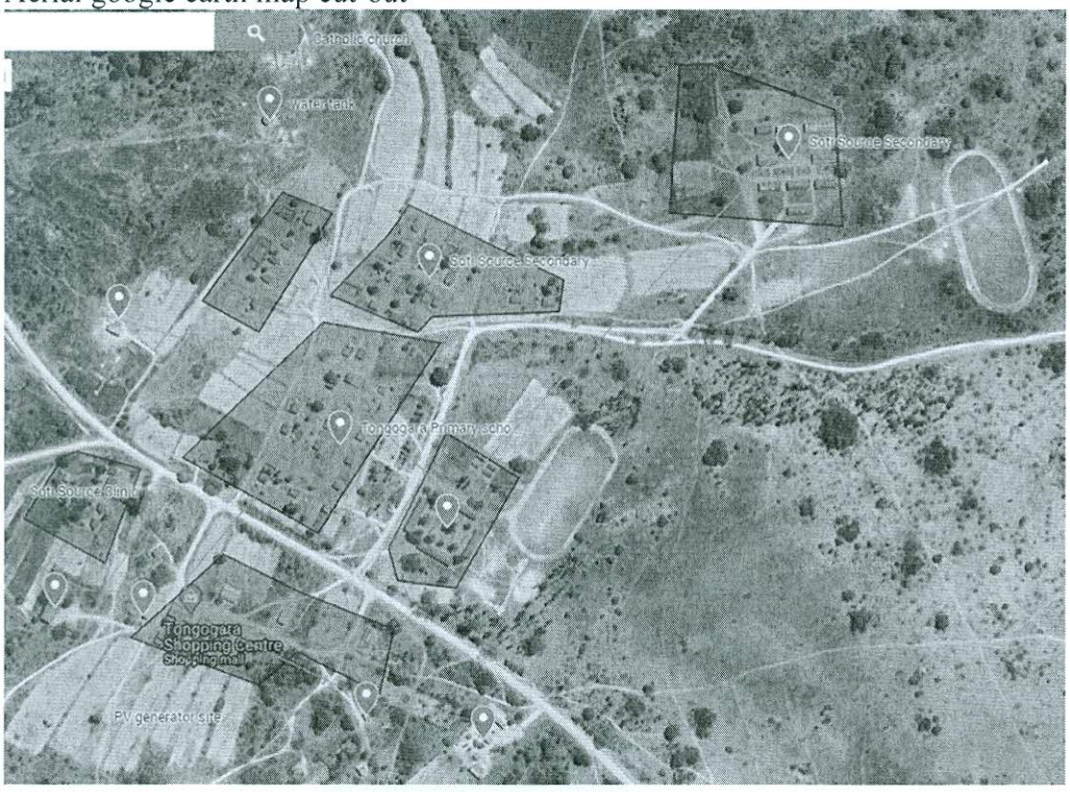


Customer Schedule

Table 17.5a – Customer Schedule for Soti Source

No.	Customer type	number	Connection type
1	village Households	15	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	8	Single phase
3	Business Centre shop	15	Single phase
4	Secondary School	1	Single phase
4	Secondary School House holds	8	Single phase
5	Clinic	1	Single phase
5	Clinic House Holds	6	Single phase
6	Churches	4	Single phase
8	VET & AREX OFFICES	2	Single phase
9	VET & AREX Staff Houses	2	Single phase
10	DDF workshop	1	Single phase
11	DDF households	4	Single phase

12	Priest House	1	Single phase
11	Productive loads (grinding mill and water pump)	2	3 phase
11	Bulk Metering	1	3 phase

Bill of Quantities:

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design

Table 17.5b – Bill of Quantities for Soti Source

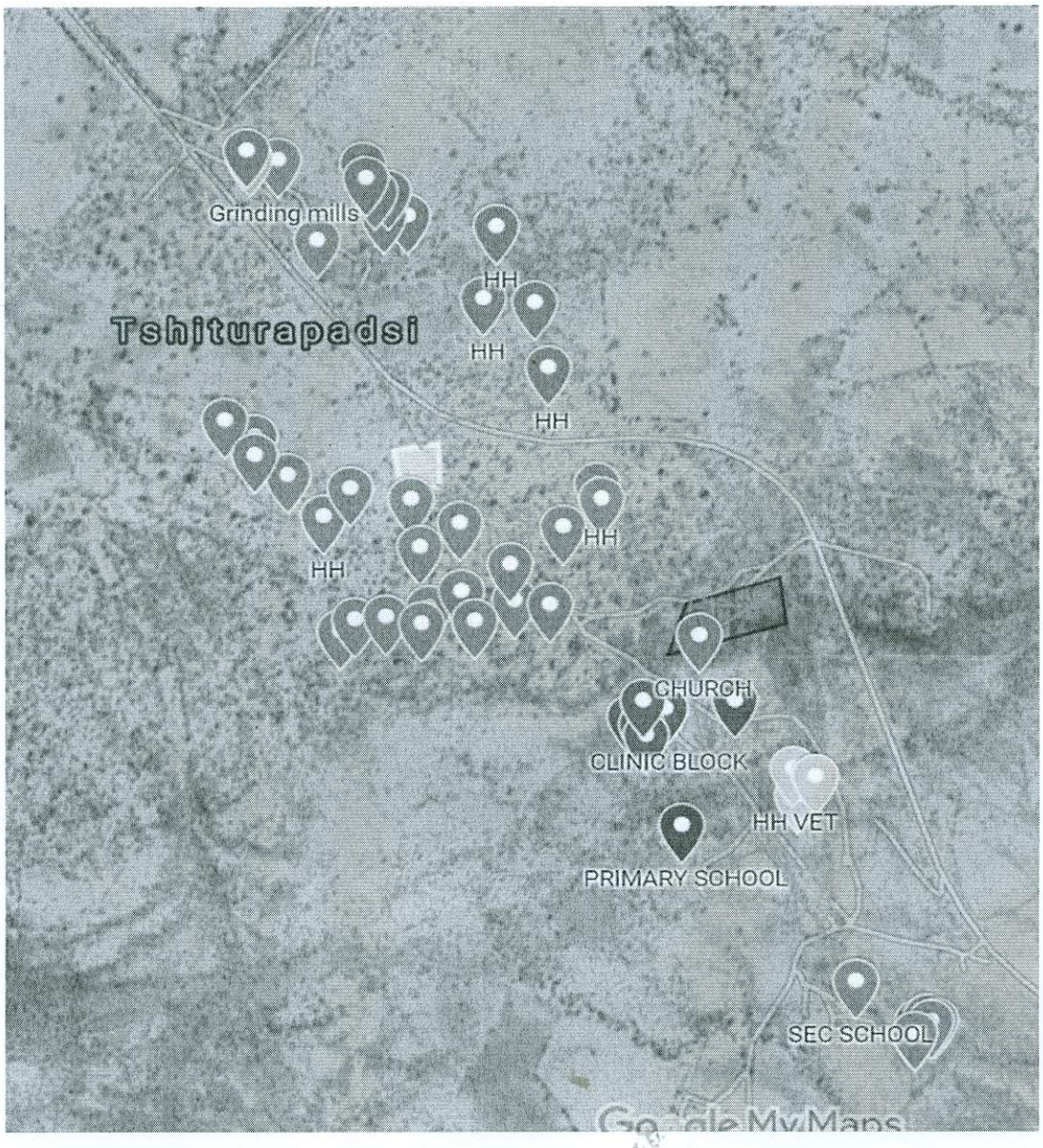
No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	400Wp	pcs	
		PV system size	150KWp for AC coupling and 10KW DC coupling	KW	
		Module Mounting Structure- to be supplied together with embedded parts for civil works	As per requirement, to support 375Wp modules	set	
		Cables	Cable length and diameter should be as per design taking into account the derating factors -PV connecting cables -Battery /inverter cables -Earthing /lightning protection cables	lot	
2	Micro grid Inverter system	GTI inverter	150kW, 400V 50Hz, 3P output	pcs	
		BBI inverter	126KW, 400V 50Hz, 3P output	pcs	
		Isolation Transformer	150kVA	pcs	
		Power cables	From inverter to transformer	set	
3	Energy Storage System(ESS)	Lithium Battery cabinet	614.4KWh, LFP	pcs	
		Power cables	Length as per design	lot	
		Communication cables	As per design	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	150KVA	pcs	
		Cables	from DG to inverter	lot	
		Communication cable	As per requirement	lot	
5	Distribution system	Lightning protection grounding grid	Lightning Protection Grounding Grid, for Grounding Package	set	

		Site accessories	Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Vending Client Software	Vending Client Software	set	
		prepaid meter-Single phase	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepaid meter-3 phase	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 5000m^2	m	

17.6 Site 6: CHITULIPASI (BEITBRIDGE-MATABELELAND SOUTH)

Site location:
https://www.google.com/maps/d/edit?hl=en&mid=1xrhTjXumOspWiXXpmzJD7QLoufkURxY4&ll=-22.194333889292277%2C30.780059561715607&z=18

Aerial google earth map cut-out



Customers Schedule

Table 17.6a – Customer Schedule for Chitulipasi

No.	loads type	number	Connection type
1	Village Households	27	Single phase
2	Primary school	1	Single phase
3	Primary school House holds	7	Single phase
3	Business Centre shops	15	Single phase
4	Secondary School	1	Single phase
4	Secondary School House holds	6	Single phase

5	Clinic	1	Single phase
5	Clinic House Holds	4	Single phase
6	Police Post	4	Single phase
8	VET & AREX OFFICES	1	Single phase
9	VET & AREX Staff Houses	2	Single phase
10	Productive loads	2	3 phase
11	Bulk Metering	1	3 phase

Bill of Quantities

The bidder is expected to give a comprehensive BOQ in the format given below according to the equipment used in the design

Table 17.6b – Bill of Quantities for Chitulipasi

No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400Wp	pcs	
		PV module capacity	≥120kw		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out , IP65	pcs	
		PV extension cable	4mm², from PV module to combiner box, As per requirement	lot	
		Cables	16mm², from combiner box to inverter , as per requirement	lot	
		Embedded parts package	As per requirement	lot	
2	Micro grid Inverter system	Micro-grid inverter	Total 120kW, 400V 50Hz, 3Phase output	pcs	
		Isolation Transformer	120kVA	pcs	
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery	496.8KWh	pcs	
		Power cables	Electric Cable,600V, 168A,UL, Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANT ONE 430U	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	N/A	pcs	
		Cables	from DG to inverter	lot	

		Communication cable	Dry contact，2*1mm²	lot	
5	Distribution system	Lightning protection grounding grid	120KW Lightning Protection Grounding Grid, for Grounding Package	set	
		pole earthing	Solution of Electric Power-Overhead line first pole earthing	pcs	
		Site accessories	120KW Site Accessories, such as: ground wire, PVC pipe, winding groove, insulation tape, tie tape, wiring terminals, cables, labels and so on	set	
6	Prepay meter system	Veding Client Software	Veding Client Software	set	
		prepay meter	Energy Meter,240V,5A,2000mW,50Hz,Single Phase	pcs	
		prepay meter	Energy Meter,400V,5A,2000mW,50Hz,three Phase	pcs	
		Single-phase Meter (one meter)	Equipment Box,80000mA,English,One epitope single phase energy meter box, wall /pole mounting	pcs	
7	remote monitor system	hardware	service , monitor unit	set	
		software	software platform, license	set	
8	Fencing	Solar Generator Perimeter Fencing	Palisade Fencing top Spiked, Height Above ground ≥2.2m rust protected Area 6000m²	m	

17.7 Site 7: GANDAVAROYI (GOKWE NORTH DISTRICT-MIDLANDS PROVINCE)

Site location
https://www.google.com/maps/d/edit?hl=en&mid=1nR7JhoLjp52mT0mglwyrHc3EXv3lINfR&ll=-17.293982741310515%2C29.119857998614272&z=18

Aerial google earth map cut-out

Customers Schedule

Table 17.7a – Customer Schedule for Gandavaroyi

No.	loads type	number	Connection type
1	Village Households	0	Single phase
2	Primary schools	1	Single phase
3	Primary school House holds	4	Single phase
3	Business Centre shops	21	Single phase
4	Secondary Schools	1	Single phase
4	Secondary School House holds	5	Single phase
5	Clinics	1	Single phase
5	Clinic House Holds	3	Single phase

6	Campfires	2	Single phase
8	VET & AREX OFFICES	1	Single phase
9	VET & AREX Staff Houses	2	Single phase
7	Productive loads	1	3 phase
8	Bulk Generator meter	1	3 phase

Bill of Quantities

Table 17.7b – Bill of Quantities for Gandavaroyi

No.	Item	Description	Specifications	unit	Quantity
1	PV system	PV module	≥400Wp	pcs	
		PV module Capacity	≥96 kw		
		Module Mounting Structure	As per requirement, can support 16pcs PV module	set	
		combiner box	5 in 1 out， IP65	pcs	
		PV extension cable	4mm², from PV module to combiner box， As per requirement	lot	
		Cables	16mm², from combiner box to inverter ， as per requirement	lot	
		Embedded parts package	As per requirement	lot	
2	Micro grid Inverter system	Micro-grid inverter	Total 90kW, 400V 50Hz, 3Phase output	pcs	
		Isolation Transformer	90kVA	pcs	
		Environment detector	smoke sensor, temperature and humidity sensor	set	
		Power cables	From inverter to transformer	set	
3	BESS	Lithium Battery	336KWh	pcs	
		Power cables	Electric Cable,600V, 168A,UL，Length as per design	lot	
		Communication cables	Twisted-Pair Cable,100ohm,Category 5e,FTP,0.52mm,24AWG,8Cores,4Pairs,PANTONE 430U	lot	
		Subassembly package	lithium battery system Accessories Package	lot	
		Battery Shelter	With Temperature management system（AC）	set	
4	Gen-set	Diesel Generator	N/A	pcs	
		Cables	from DG to inverter	lot	
		Communication cable	Dry contact，2*1mm²	lot	

PART III: FURTHER INFORMATION FOR BID PREPARATION

18.0SYSTEM DEMONSTRATION AND TRAINING

18.1System Demonstration

Each selected developer is required to conduct system demonstration testing to ensure that the system works as intended and meets the stated quality, performance and functional requirements.

18.1.1Installed mini-grid Demonstration Testing

During the demonstration, testing, selected developers shall install mini-grid systems to independently conduct system demonstration testing. The demonstration testing includes but is not limited to component, subsystem and system level tests and associated performances claimed in section 5 above.

18.1.2System Functional Testing with Loads

Based on the specific system design and components provided by each developer, REF will require each developer to conduct system functional testing using electrical loads specified in section 3.1. During system demonstration, REF will verify all high-level system requirements stated in section 3.2 including system stability at start up and normal operating conditions.

18.1.3 System Demonstration Evaluation Criteria

Each developer will be evaluated by comparing stated performance and quality specifications to actual performance and quality specifications. The stated values are expected to be within 5% of the actual demonstrated values.

No	Specification	Developer Stated Value	Actual Demonstrated Value
1	Solar Array Efficiency		
2	Solar Charge Controller Efficiency		
3	Battery Cell Balancing Performance		
4	Battery module Efficiency		
5	Inverter Efficiency		
6	Overall System Efficiency		
7	Design for Transportation		
8	Design for Reliability		
9	Performance and accuracy of battery state of charge reporting system		
10	Load prioritization function (automatically toggle between critical load and auxiliary non-critical load during excess power generation)		
11	Design for Standby Power		

18.2Training

The selected bidder is required to conduct detailed training for REF staff at the selected mini-grid pilot sites in Zimbabwe.

18.2.1Training Requirements

The selected developer shall provide a minimum of two (2) weeks of training for ten (10) technical engineers on the following areas:

- Electrical System Safety and Personnel Safety Training
- Photovoltaic Array Installation Training
- System Installation Training
- System Commissioning and Operation Training
- System Control and Monitoring Training
- Managing Alarms and Shutdowns
- Management of Critical Loads and Non-critical Loads
- Full System Maintenance Training
- System Repairs and Replacement Training
- Training on use and Administration of Centralized Monitoring System

18.2.2Training Documentation

Each selected developer shall provide required training manual and qualified training staff to conduct the training effectively for the trainings listed in section 6.2.1. Suppliers will be graded on the following:

- Quality and content of training materials
- Ease of Solar Array Installation
- Ease of System Installation
- Ease of Maintenance
- Ease of Repair and Replacement
- Ease of Commissioning and Operation
- Ease of Control and Monitoring
- Functionality and ease of use of Centralized Monitoring System

19.OPERATIONAL REQUIREMENTS

19.1Installation of Unit

19.1.1Compliance

The mini-grid module must be installed in compliance with the design specs and the Environmental Requirements outlined in this document within four months of getting the award.

19.1.2Plan and checklist

The supervising contractor, before commencement of construction works, shall develop a detailed monitoring plan to check the effectiveness of safety measures during implementation. This shall be consistent with the REF ESMG.

19.2 Commissioning and Test

19.2.1Scope of Commissioning

The PV Mini-grid once installed in its final location must undergo commissioning tests using simulated loads to verify expected performance for different operation scenarios in the presence of REF staff.

19.2.2 Documentation of commissioning results

The commission test results must be documented and presented to the REF staff for signature of acceptance.

19.2.3Acceptance of commissioning

The REF staff signature of acceptance must be received before the unit is turned on to start service to the connected loads. The date of acceptance marks the start of the In-Service day of operation of the Mini-grid servicing all connected loads.

19.3Operational Responsibilities

The mini-grid supplier is responsible for safe handling of the unit during transportation, during installation and for safe keeping during the commissioning. The supplier is also responsible for any damages it causes to people and property.

20.ENVIRONMENTAL REQUIREMENTS

20.1Minimize Interference on Pre-existing Systems

The alternative installation spots for the Mini-grid units acceptable to the community will be presented to all bidders during the site visit period specified for each site in the bid document or instructions.

The unit must be installed in a space that has the least impact on the ecosystem. Mature trees must be retained as much as possible and trees clearing must be avoided. Provisions must be provided to protect the unit from local birds and animals caused damages and from any vegetation growing around.

20.2 Layout Design

20.2.1FOOT PRINT OPTIMIZED

The Mini-grid design layout must be optimized for reduced footprint, taking the lowest space and resources utilization possible, within its rated capacity.

20.2.2PRE-EXISTING Considerations

The PV panels' layout should take into consideration the surrounding pre-existing occupants and blend in favourably to reduce unacceptable appearance in the area.

Light Reflections, glare and other unacceptable visual interferences on neighbouring occupants must be avoided by varying the size and orientation of the PV panel supporting structure.

20.2.3 Grid Corridor

The mini-grid generation plant, wiring and cables must be laid out in the specified right-of way that is not encroaching into others pre-existing places without written consent.

20.2.4 Use of safe paints
Any of the Mini-grid parts that must be painted must use safe and nontoxic paints that will not easily fade or leach into the surrounding environment.

20.2.5 Disposition of other waste
All waste that came with the units like packing materials, metal scraps and paints must be safely recycled and or safely disposed at the appropriate place.

21.HEALTH AND SAFETY PRACTICES

The winning supplier must comply and follow the REF Environmental and Social Management Guidelines (ESMG) for ensuring workers safety on the project and protection of the environment.

22.DRAWINGS AND SUPPLEMENTARY INFORMATION

The Purpose of drawing is to specify locations, dimensions, size, materials to be used and other characteristics of the goods and related services. The bidder shall prepare all the required drawings and include them in the technical proposal and will be part of the system design and technical bid. Including Solar Mini-grid generation system layout, Powerhouse location for the lots quoted, and ground mounted solar PV modules, Isometric view of Solar PV array, Detail drawing of powerhouse and control room are required,

APPENDIX 1

DECLARATION ON NON-ENGAGEMENT IN CORRUPT OR FRAUDULENT PRACTICES FORM

The Chief Executive
Rural Electrification Fund
6th Floor Megawatt House
44 Samora Machel Ave
P. Bag A250
Avondale
Harare
Zimbabwe

TENDER NUMBER: _____
TENDER DESCRIPTION: _____

I_____ the undersigned (*Director of Company*) on behalf of _____ (*Name of Organisation*), do hereby declare that our organization has not been engaged in any corrupt or unethical practices during the subsistence of our organisation.

Name in Full _____

I. D. Number _____

Signature _____

Annexure 2

LETTER OF TENDER (TENDER FORM)

NAME OF TENDER: Supply & Delivery of .....

Tender Number REF/...../...../2021

TO: The Chief Executive

Rural Electrification Fund (REF)
6th Megawatt House,44 Samora Machel Avenue,
Harare, Zimbabwe

We, [*insert name of Tenderer*], herewith enclose a Tender for selection of our firm as Contractor/Supplier for .....
We have examined the Conditions of Contract, Employer's Requirements, Schedules, the attached. Appendix and Addenda Nos __ of the above-named Works. We have examined, understood and checked these documents and have ascertained that they contain no errors or other defects. We accordingly offer to design, execute and complete the Works and remedy any defects therein, in conformity with this Tender which includes all these documents and the enclosed Proposal, for the lump tender sum of: USD_____

We agree to abide by this Tender until _date__/_month___/_year___ [i.e. _____ days from the tender opening date] and it shall remain binding upon us and may be accepted at any time before that date. We acknowledge that the Appendix to Tender forms part of this Letter of Tender.
If this offer is accepted, we will provide the specified Performance Security, commence the Works as soon as is reasonably practicable after the Commencement Date, and complete the Works in accordance with the above-named documents within the Time for Completion. We guarantee that the Works will then conform to the Schedule of Guarantees.
Unless and until a formal Agreement is prepared and executed, this Letter of Tender, together with your written acceptance thereof, shall constitute a binding contract between us. Our Tender is binding upon us and subject to the modifications resulting from pre-award contract negotiations.
We understand that you are not bound to accept the lowest or any tender you may receive.

Signature _____ in the capacity of _____

Duly authorized to sign tenders for and on behalf of _____

Address: _____

Date: _____

Date _____