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DRUK HOLDING & INVESTMENTS LTD.

GROUP STANDARD BIDDING DOCUMENT

GOODS and Services



Part I: NOTICE INVITING TENDER

NIT No: BT/Supply, Delivery, Installation & Commissioning of Power, Tower & Shelter/2023

1. Bhutan Telecom Lt invites eligible bidders to submit your ebids for the supply of **Supply, Delivery, Installation & Commissioning of Power, Tower & Shelter.**
2. Bhutan Telecom Ltd would like to inform the interested firms to kindly visit the website www.tender.bt for vendor registration and to submit the proposal online.
3. The user manual for vendor registration and bidding process is available on the website www.tender.bt or else can be downloaded from following links:-User manual for vendor registration-User manual for Bidding process.
4. SBD Timeline

NIT No.	BT/Power Equipment/2022
Bid Submission & EMD Submission Date & Time	On or before 2 nd January 2023 (17:00 hrs)
Bid Opening Date & Time	3 rd January 2023 (14:00 hrs)
RFP shall be available at	www.tender.bt

Part II: Terms and Conditions

1 Scope of Supply

- a. The bidder(s) may quote for all items and services as per the technical specification as attached. The scope of work includes supply, Installation and Commissioning of Power, Tower and Shelters at various sites. The supply component will involve the supply of Power , Tower ,Shelter, DEG and its accessories (TO BE QUOTED CIF PHUENTSHOLING, BHUTAN), whereas the service component will include transportation of materials up to individual sites and erection of towers. You are **required to quote separately** for supply and services as per the format provided in eProcurement.
- b. The vendor or contractor can also quote for services only.

2 Clarification to the bidding document

Further information can be obtained in writing from manager.accessnetwork@bt.bt/manager.procurement@bt.bt/procurement@bt.bt not later than 27th December 2022.

3 Documents comprising bid

- 3.1 The bid must be accompanied by the following document:
 - a) Bid Security
 - b) Valid Trade license
 - c) Tax clearance
 - d) OEM Certificate for the Equipment
 - e) Any other relevant documents as required

4 Bid Price

- 4.1 All prices shall be quoted in BTN/INR. The quoted price shall be CIF, Thimphu including taxes, duties and other levies to the final place of delivery, if required.
- 4.2 The final place of delivery of Equipment is CIF Phuntsholing and the services to be from Pling to the sites.
- 4.3 Each item shall be evaluated and contract awarded separately to the firm(s) offering the lowest evaluated price for each item.

Or
- 4.5 The bidder(s) must quote for all the items under this bid if in lot. Price bids will be evaluated for all the items together and contract awarded to the firm offering the lowest evaluated total cost of all the items.
- 4.6 All prices quoted shall be on a per unit basis and valid till **for 12 months** from the date of bid

opening. The selected bidders shall be contacted for additional supply of any enlisted item in future on repeat order basis for the entire contract period.

5 Bid Validity

- 5.1 The bid shall be valid for 12 months from the date of submission of the bid. In exceptional circumstances, prior to the expiration of the bid validity period, the Purchaser may solicit the Bidder's consent to an extension of the bid validity period. The request and responses shall be made in writing. A bid valid for a shorter period shall be considered non-responsive.

6 Bid Security

- 6.1 The bid shall be accompanied by the bid security of **2% of the bid value** in the form of Cash Warrant/ Unconditional Bank Guarantee/ Banker Cheque/ Demand draft in the name of the **Chief Executive Officer, Bhutan Telecom Ltd** issued by the Financial Institution enforceable in any Banks in Bhutan.
- The Bid security shall be valid up to 90 (Ninety) days.
 - The Bid Security is to be submitted as a part of the Bid in a separate sealed envelope and be submitted to Finance & Accounts Division or to our nearest Branch Office within the specified time in SBD timeline.
 - Any Bid not accompanied by bid security of adequate value and validity shall be rejected by the Purchaser and considered as non-responsive.
- 6.2 The bid security shall be forfeited in the following cases:
- If the Bidder withdraws the bid after Bid opening during the period of Bid validity.
 - If the Bidder does not accept the correction of the Bid price;
 - In the case of a successful bidder, if the bidder fails within the specified time limit to sign the Contract or furnish Performance Security.

7 Purchaser's Right to Accept Any Bid, and Reject any or All Bids

- 7.1 The Purchaser is not bound to accept the lowest bid and reserves the right to accept or reject any or all the bids without assigning any reason whatsoever.
- 7.2 The Purchaser also reserves the right to reject/cancel the local transportation and relevant services orders post issuance of work order if pandemic situation or any other unforeseen disaster.
- 7.3 The purchaser also reserves the right to separate the supply of goods and services, and award the supply and services to different vendors/contractors.
- 7.4 The purchaser also reserves the right to make as different packages and award the services to multiple vendors/contractors.

8 Quantity Variation

- 8.1 Depending on the final requirement, at the time of the award of the Contract, the Purchaser may increase or decrease the quantities by twenty five percent (25%) of the indicated quantity.

9 Award of Contract

- 9.1 The Purchaser shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated Bid with all the required specification. The Purchaser shall issue Notification of Award/ Purchase Order to the successful Bidder. Until a formal Contract is prepared and executed, the Notification of Award/Purchase Order shall constitute a binding Contract.

10 Delivery Schedule

- 10.1 The contractor shall supply, install and commission the work specified from date of placing purchase order. Supply within 2 (two) months from the issue of purchase order and services within 3 (three) months from the date of issue of purchase order failing which the contractor shall be liable for liquidated damages as specified detailed in clause 12.1 for both the supply and installation accordingly.
- 10.2 The delivery for Tower Foundation Bolts & Templates, Shelter Foundation templates, solar foundation bolts and templates has to be delivered within 20 (twenty) days from the date of issue of supply order failing which the contractor shall be liable for liquidated damages as specified detailed in clause 12.1.
- 10.3 The start date of the services will be the 3 days after informing the completion of civil work or delivery of materials at the Phuntsholing whichever is later.
- 10.4 Contractor/Vendor should share the tentative work plan for all the sites (Tower, power, shelter, monopole and DEG) which is subject to change according to civil work and materials delivery but the time period shouldn't be changed.
- 10.5 Contractor/Vendor should provide break up cost as per the attached site details.

11 Performance Security

- 11.1 The Supplier shall be required to furnish Performance Security of 10% of the quoted price in the form of cash warrant, demand draft or unconditional Bank Guarantee in the name of Chief Executive Officer, Bhutan Telecom issued by a financial institution enforceable in any Banks in Bhutan, which shall be furnished upon issuance of notification of the award. Performance Security shall be valid till the end of warranty period and will be returned after the end of warranty period.

12 Liquidated Damage

- 12.1 If the Supplier fails to deliver any or all of the Goods by the date(s) of delivery or fails to perform the Related Services within the period specified in the Contract/ Purchase Order, the Purchaser shall deduct Liquidated Damages at the rate of **0.1%** per day for each day to a maximum of 10% of the total PO Value.

13 Payment Terms

13.1 For Supply of goods

- 13.1.1 CIF price of goods shall be paid as under: Progressive Payment: Fifty percent (50%) of the CIF price component for all the equipment and materials shall be paid on proof of dispatch. Supplier to furnish all the documents for payment purpose.

- 13.1.2 The balance fifty percent (50%) of the CIF price for the materials component shall be paid after reaching to the designated place.

13.2 For Services:

- 13.2.1 Expatriate supervision & Local service charge i.e., transportation and erection/commissioning charges shall be paid as follows:
- a) Seventy percent (70%) of the charges shall be paid after completing all works including user acceptance test (UAT).
 - b) Thirty percent (30%) of the charges shall be paid as advance.
 - c) The vendor or contractor should submit user acceptance test (UAT) with proper handover/completion date signed by concerned officials/PC managers and endorse by Regional Director.
- 13.2.2 At the time of release of payment, Tax /FCT (3%) shall be deducted at Source from the gross amount of bills as per the Income Tax Act of the Bhutan. The Purchaser shall furnish necessary TDS Certificate to the Bidders, issued by the Department of Revenue & Customs, RGoB.

14 Warranty Period

- 14.1 The contractor shall warrant that the equipment and materials supplied shall be new and free of defects and that the contractor shall be responsible for any defects that may develop within the warranty period of 12 months from the date of commissioning/erection.
- 14.2 The Supplier shall be bound to rectify the fault or replace the Goods as the case may be. The performance security shall be used to cover the cost of supplies not delivered or defective items not replaced or rectified.
- 14.3 Any goods found defective during the warranty period shall be replaced/ repaired by the supplier at his cost. If the supplier fails to rectify and or replace the defective goods, the Purchaser shall do it at the cost of the supplier.

15 Contractor's Responsibility

- 15.1 The contractor shall perform the work stipulated in clause 10 above.
- 15.2 The contractor shall take full responsibility of performance, stability, reliability and durability of the facilities installed
- 15.3 The contractor shall complete the supply and service component within 5(five) months as stipulated in Clause 9.
- 15.4 A fortnightly progress report shall be submitted giving the details on the progress of supply, installation and commissioning of the system.
- 15.5 Any part of the work found not to the satisfaction of Bhutan Telecom shall be remedied at the expense of the contractor
- 15.6 Packaging and delivery of the materials should be done site wise and PO wise.
- 15.7 Bidder or their representative should visit the site before submission of bids and full covid-19 protocols put in Place by Royal Government of Bhutan must be followed diligently. BT shall provide preliminary data as reference.
- 15.8 The contractor shall be fully responsible for the deviation of work scope for not adhering as specified above.
- 15.9 Head loading of materials should be CIF site identified by BT.

- 15.10 Bidder should submit exclusive services cost breakup including transportation, head loading, installation and commissioning for tower, monopole, shelter and power. The service cost pertaining to tower, shelter and power can be broken up and allotted to different vendors.
- 15.11 The contractor shall deploy minimum of one team per region for execution of tower, shelter and power.
- 15.12 Bidder shall submit exclusive cost breakup for hardware and services.
- 15.13 The contractor shall handover balance materials to respective region/local BT offices or CHQ project section with proper signed handing taking document. The contractor shall clean station and its surrounding and dispose wastes at the safe place post installation in accordance to the National Environment Commission policy.
- 15.14 The contractor shall be fully responsible for any damages caused except force majeure prior to Acceptance test /handing taking.
- 15.15 The successful bidder/contractor shall submit the implementation schedule on the supply, civil works, installation and commissioning of tower, shelter and power based on the work plan shared by BT.
- 15.16 Any part of the work found not to the satisfaction of BT shall be remedied at the expense of the contractor.
- 15.17 The contractor shall supply any additional orders at the unit price within the Contract period. The Employer shall decide the location of supply.
- 15.18 The contractor shall ensure availability of spares within warranty period.
- 15.19 The contractor shall follow guidelines of COVID-19 Protocol issued by Royal Government of Bhutan and any expenses pertaining to COVID-19 shall be borne by contractor. The expenses include the logistic and medical expenses for the employees of contractor/supplier.
- 15.20 The contractor shall be fully responsible for transportation of materials on transship while BT will facilitate approval from agencies.
- 15.21 The contractor shall develop and level the sites which includes tree felling while BT shall support and facilitate in obtaining approval from agencies.
- 15.22 At least 6 (six) team should be ready and available to deploy the works
- 15.23 The contractor should visit site before quoting as the Headload provided by BT is just for reference and not on actual.
- 15.24 All the Drawings submitted from Contractor end for the equipment shall be as per the design shared by BT. Failing to submit the drawings as per the design shared shall lead to rejection.

16 Bhutan Telecom's Responsibility

- 16.1 Bhutan Telecom shall take necessary measures to accord personnel of contractor such facilities as issuance of visas, permits and other authorizations necessary for the entry into Bhutan and travel to the sites.
- 16.2 Bhutan Telecom shall be responsible for all the taxes and levies in Bhutan except the 3% Foreign Contract Tax (FCT) on the turn key (goods along with services), which shall be borne by the contractor which is specified detailed in Clause no. 13.3 above.
- 16.3 BT shall acquire land and hand over to contractor.
- 16.4 BT also reserves right to change in implementation schedule based on the priority, which will be informed in advance to the contractors.

17 Inspection and Testing

- 17.1 The contractor shall conduct standard tests in presence of Bhutan Telecom representatives to conform to general technical standards.
- 17.2 Should any tested/ inspected goods/ materials fail to conform to the specifications Bhutan Telecom may reject them and the contractor shall replace the rejected goods/material or make alteration necessary to meet the specifications without any cost to Bhutan Telecom.

18 Submission of Bid

- 18.1 The Bidder shall submit the bid online and Bidder shall submit Bid Submission Form using the Form in the Annexure I if so required in the Clause no. 3 above: This form must be completed without any alterations to its format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.
- 18.2 As such a bid in which the Bid Submission Form. Not duly filled, signed and sealed by the bidder shall be rejected.

19 Termination

- 19.1 The Purchaser may, by written notice, terminate the Purchase Order or Contract in whole or in part at any time for its convenience:
 - a) if the Supplier fails to perform any other terms and conditions specified with the Purchase Order/ Contract, or exceeds the maximum amount of Liquidated Damages; and
 - b) If the Supplier fails to perform any other obligation(s) under the Purchase Order / Contract, and if the Supplier does not take any remedial action within a period of one month after receipt of a notice of default from the Purchaser specifying the nature of the default(s).

20 Force Majeure

- 20.1 Either party shall be excused from the performance or punctual performance of any of its obligations under this contract, and such obligations shall be extended for a period reasonable under circumstances, if the performance of this contract is prevented or delayed by any cause beyond the effected parties' reasonable control which, without in any way limiting the generality of the foregoing, shall include acts of God, riots, wars, earth quakes, storms, cyclone landfall, lightning, landslides, accidents, pandemic, embargo or requisition (acts of government), including non-availability of visas and permits for contractors' personnel, or delays in the performance of its subcontractors caused by any such circumstances.
- 20.2 Non-availability or withdrawal of any export/import licenses for the goods or any part thereof in this contract cannot be considered as force Majeure events.
- 20.3 Events caused due to animals and theft cannot be considered as force Majeure events.
- 20.4 In case of Force Majeure, the contractor shall promptly notify the employer in writing and furnish the employer with all relevant information thereto.
- 20.5 Should a cause of force majeure continue for more than one (1) month, either party shall then have the right to terminate this Contract.

21 Governing Law

21.1 The Contract/ Purchase Order shall be governed by and interpreted in accordance with the Laws of Bhutan.

22 Dispute Resolution

22.1 Any settlement of dispute or arbitration of matter arising from the contract shall be settled as per the Alternative Dispute Resolution Act of Bhutan 2013 for Bhutanese Supplier and United Nations Commission on International Trade Law [UNCITRAL] Arbitration Rules of 1976 for International Supplier and will be binding for both parties.

Part III: Forms:

Annexure-I Bid Submission Form

[The Bidder shall fill in this form in accordance with the instructions indicated. No alterations to its format shall be permitted and no substitutions shall be accepted.]

Date :*[insert date of Bid submission]*

Tender No.:*[insert number]*.

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

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda number:..... *[Insert the number and date of issue of each addendum]*;
- (b) We offer to supply in conformity with the Bidding Documents and in accordance with the Schedule of Supply the following Goods and Related Services: *[insert a brief description of the Goods and Related Services]*;
- (c) The total price of our Bid, excluding any discounts offered in item is: *[insert the Bid Price in words and figures, indicating the various amounts and their respective currencies]*;
- (d) The discounts offered and the methodologies for their application are:

Discounts. If our Bid is accepted, the following discounts shall apply: *[Specify in detail each discount offered and the specific item of the Schedule of Supply to which it applies.]*

Methodology of Application of the Discounts. The discounts shall be applied using the following methodology: *[Specify in detail the methodology that shall be used to apply the discounts]*;

- (e) Our Bid shall be valid for a period of *[insert number]* from the date fixed for the Bid submission deadline and it shall remain binding upon us and may be accepted at any time before expiry of that period;
- (f) If our Bid is accepted, we commit to provide a Performance Security in accordance with Clause 15 for the due performance of the Contract;
- (h) We, including any subcontractors or suppliers for any part of the Contract, have nationality from eligible countries, viz: *[insert the nationality of the Bidder, including that of all parties]*

that comprise the Bidder if the Bidder is a JV/C, and the nationality each subcontractor and supplier]

- (i) We have no conflict of interest;
- (j) Our firm, its affiliates or subsidiaries - including any subcontractors or suppliers for any part of the contract - has not been declared ineligible by the Purchaser under the laws or official regulations of Bhutan;
- (k) We have read the terms and conditions carefully, understood and agree to comply with all the clauses which are mentioned therein. In case of any breach of any condition on our part, we shall be liable for actions as per terms and conditions of the Contract.
- (l) We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed.
- (m) We understand that you are not bound to accept the lowest evaluated Bid or any other Bid that you may receive.
- n) We accept the Vendor Performance Management System.

Signed: _____ [insert signature of person whose name and capacity are shown]

In the capacity of _____ [insert legal capacity of person signing the Bid Submission Form]

Name: _____ [insert complete name of person signing the Bid Submission Form]

Duly authorized to sign the bid for and on behalf of: _____ [insert complete name of Bidder]

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

Annexure II- Performance Security Form

[The bank, as requested by the successful Bidder, shall fill in this form in accordance with the instructions indicated]

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

IFB No. and title: *[Insert no. and title of bidding process]*

Bank's Branch or Office: *[Insert complete name of Guarantor]*

Beneficiary:..... *[Insert complete name of The Company]*

PERFORMANCE GUARANTEE No.:..... *[insert Performance Guarantee number]*

We have been informed that *[Insert complete name of Supplier]* (Hereinafter called "the Supplier") has entered into Contract No..... *[Insert number]* dated *[Insert day and month]*, *[Insert year]* with you, for the supply of *[description of Goods and related Services]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a Performance Guarantee is required.

At the request of the Supplier, we hereby irrevocably undertake to pay you any sum(s) not exceeding *[insert amount(s)¹ in figures and words]* upon receipt by us of your first demand in writing declaring the Supplier to be in default under the Contract, without cavil or argument, or you needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This Guarantee shall expire no later than the *[Insert number]* day of *[Insert month]* *[Insert year]*, ² and any demand for payment under it must be received by us at this office on or before that date. We agree to a one-time extension of this Guarantee for a period not to exceed *[six months]* *[one year]*, in response to The company's written request for such extension, such request to be presented to us before the expiry of the Guarantee.

[Signatures of authorized representatives of the bank and the Supplier]



Annexure III- Contract Forms

[The successful Bidder shall fill in this form in accordance with the instructions indicated]

THIS CONTRACT AGREEMENT made the *[Insert number]* day of *[insert month]*, *[insert year]*,

BETWEEN

1. (1) *[insert complete name of Purchaser]*, a *[insert description of type of legal entity, for example, an agency of the Ministry of ... of the Government of Bhutan, or corporation incorporated under the laws of Bhutan]* and having its principal place of business at *[insert address of Purchaser]* (hereinafter called “The company”), and
2. (2) *[Insert name of Supplier]*, a corporation incorporated under the laws of *[Insert country of Supplier]* and having its principal place of business at *[insert address of Supplier]* (Hereinafter called “the Supplier”). WHEREAS The company invited Bids for certain Goods and ancillary services, viz., *[insert brief description of Goods and Services]* and has accepted a Bid by the Supplier for the supply of those Goods and Services in the sum of *[insert Contract Price in words and figures, expressed in the Contract currency/ies]* (hereinafter called “the Contract Price”). NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

The following documents shall constitute the Contract between The company and the Supplier, and each shall be read and construed as an integral part of the Contract, viz.:

- (a) This Contract Agreement;
- (b) The Special Conditions of Contract;
- (c) The General Conditions of Contract;
- (d) Technical Requirements (including Schedule of Supply and Technical Specifications.)
- (e) The Supplier’s Bid and original Price Schedules;
- (f) The company’s Notification of Award of Contract;
- (g) The form of Performance Security;
- (h) The form of Bank Guarantee for Advance Payment;



(i) *[Insert here any other document(s) forming part of the Contract]*

This Contract shall prevail over all other Contract documents. In the event of any discrepancy or inconsistency within the Contract documents, then the documents shall prevail in the order listed above.

In consideration of the payments to be made by The company to the Supplier as

3. Hereinafter mentioned, the Supplier hereby covenants with The Company to provide the Goods and Services and to remedy defects therein in conformity in all respects with the provisions of the Contract.
4. 5. The company hereby covenants to pay the Supplier in consideration of the provision of the Goods and Related Services and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
5. IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Bhutan on the day, month and year indicated above.
6. For and on behalf of The company Signed: *[insert signature]*
7. In the capacity of*[insert title or other appropriate designation]* in the presence of*[insert signature]**[insert identification of official witness]*
8. For and on behalf of the Supplier Signed:.....*[insert signature of authorized representative(s) of the Supplier]*
9. In the capacity of*[insert title or other appropriate designation]* in the presence of*[insert signature]* *[insert identification of official witness]*

23 Technical Specification

23.1 Specifications of Power

23.1.1 General

- 23.1.1.1 The Power Supply Facilities shall supply stable and uninterrupted power to maintain normal performance of the GSM Base- stations/Repeaters, Back-haul radio system and associated equipment. The Power supply facilities to be provided shall be composed of Storage Batteries, Rectifiers, air-conditioners, ventilations and others.
- 23.1.1.2 Power supply equipment block schematic, wiring diagram including the type, the size and the number of wires must be provided.

23.1.2 Storage Batteries

23.1.2.1 General Requirements

- 23.1.2.1.1 The storage Batteries shall be so designed as to hold at least twelve (12) years life when operated on full-floating basis.
- 23.1.2.1.2 The storage batteries shall be provided with suitable detector to be used for detection of the condition of extant capacity, and each battery shall be so designed as to be equipped with such detector to be used with supervisory and control for O&M purposes.

23.1.3 Type

- 23.1.3.1 The storage batteries shall be maintenance free Vent Regulated Lead Acid (VRLA) type.
- 23.1.3.2 The container shall be strong enough to withstand rough handling.
- 23.1.3.3 Explosion-proof vent plug shall be provided at the upper part of the container.
- 23.1.3.4 The batteries shall be designed for operation in ambient temperature of –20 to +45 deg. Celsius

23.1.4 Composition

- 23.1.4.1 The storage batteries proposed shall be divided into at least two (2) banks for the all GSM base stations.
- 23.1.4.2 The steel rack finished with acid-resistant paint shall be supplied.
- 23.1.4.3 The numbering seal for battery cells and each battery bank shall be provided.

23.1.5 Capacity

- 23.1.5.1 The capacity of each storage battery shall be calculated at the temperature from -15° C to 40°C (The altitude of the selected sites for the Project ranges from 160m in the south to 4000m in the north).
- 23.1.5.2 For full-floating power supply system, the capacity of storage batteries shall be sufficient to supply ten (10) hours load for the telecommunications equipment in case of Power supply failure. (Approximately, load of 20KW should be taken into account).

23.1.6 Special Requirement for Batteries

- 23.1.6.1 The batteries shall be low maintenance type such that routine battery maintenance is not required.
- 23.1.6.2 The batteries shall be of solid construction, suitable for transportation over rugged terrain.
- 23.1.6.3 The batteries shall have a low self-discharge rate. Prospective bidders shall state the self-discharge rate of –15, 25 and 45 deg. Celsius.
- 23.1.6.4 It shall be possible for the batteries to be charged with an external backup system.

23.1.7 Information

The following information shall be included in the proposal:

- 23.1.7.1 Type of storage batteries proposed and name of manufacturer.
- 23.1.7.2 Calculation basis of storage battery capacity.
- 23.1.7.3 Discharge characteristics for ten (10) hours, twenty (20) hours and two hundred (200) hours rate.
- 23.1.7.4 Number of cells used in one bank.
- 23.1.7.5 Operation life.
- 23.1.7.6 Full weight, empty weight, electrolyte volume and dimensions of each cell.
- 23.1.7.7 General description concerning installation, operation and maintenance works.

23.1.8 Room Air Conditioner

The proposed dual type inverter air condition shall be of both Window and Split type (ranging from 1.5 TON), to ensure that the internal ambient temperature remains within the range of 25 degree Celsius. The Air conditioner should meet the following system

- 23.1.8.1 Characteristics:
 - a) Operating Voltage: 220V (+5 and/- 10%)
 - b) Duty: Continuous.
 - c) Power consumption: Less than 1000 Watts for window type and 2000 W for Split type.
 - d) Condenser Fan: Axial flow
 - e) Evaporator Fan: Centrifugal
 - f) AC refrigerant should be 410A
 - g) Controls: Microprocessor control.

23.1.9 Earthing and Bonding

To ensure maximum safety and system reliability, a high grade earthing shall be provided with an earth resistance less than 2 Ohms for each site.

23.1.9.1 Technical Details

- a) Earthing system shall consist of earthing materials, earthing terminal box to be installed in an applicable room, etc.
- b) All the equipment including fuel tanks, panels and all other non-current carrying metallic parts of the equipment shall be earthed.

- c) The earthing materials shall be installed not less than 800 mm deep from the ground level.
- d) If earth rods are used, they shall be driven into the ground until the top of each rod is approximately at the same depth as the earthing wire.
- e) The earth resistance shall be so designed to maintain the safety operation of the system.
- f) The measured soil resistivity and calculation data of earthing system shall be submitted to the Employer.
- g) Earthing wire shall have enough capacity to carry fault current of the system to the ground.
- h) Where the designed earth resistance cannot meet with the actual earth resistance value at site, additional earth rods, or other applicable procedures shall be provided to meet the design requirements.
- i) All earthing wires penetrating the building shall be installed in a rigid plastic conduit, and shall be sealed by non-flammable materials to prevent the ingress of the dust, water and fire.
- j) The earth resistance shall be less than 2 ohms for safe operation of telecom equipment.

23.1.10 Rectifier units

The bidder should submit the type of rectifier and the manuals. The rectifier shall have the house keeping alarms extension facilities to the NOC. Name plate of the installation date and site name should be pasted on the Rectifier. Rectifier should have the stand.

23.1.11 Ventilation system

All shelter shall have DC (-48VDC) with power consumption less than 2 Amps. The ventilation shall be one inlet with four Fans and one outlet with four fan exhaust fan. The inlet shall have good dust proof system and easy to carry out the maintenance. The vendor should provide manual system for installation and maintenance.

23.1.12 Inspection and Test:

The Supplier/contractor must inspect the goods prior to dispatch to ensure conformance to specification and/or any other provisions of the contract. BT reserves the right to inspect the goods for compliance with specifications and provisions of the contract at the factory before dispatching of the equipment at BT site. If, in the BT's opinion, the goods and/or services do not comply with the specification, the BT will inform the Supplier/contractor in writing. In such a case the Supplier/contractor shall take the necessary action to ensure compliance, liability for any additional cost incurred for rectifying.

23.2 Specifications of Towers

23.2.1 General

23.2.1.1 Tower should have the name plate with Company Name as Bhutan Telecom Limited, tower height and specification, installation date and installed by.

23.2.1.2 Vendor needs to share the name plate design.

23.2.2 Structural Design

23.2.2.1 Unless otherwise specified, the antenna supporting structure shall be self-supporting type and foundation shall be of reinforced concrete.

23.2.2.2 Any stress of component of facilities, of steel, bolt, reinforcing bar and concrete shall not exceed allowable stress of material specified in the standard.

23.2.2.3 The design for steel structure shall be based on the following concept and assumption in case if the tower structure to be constructed:

- a) Steel structure shall be regarded as an elastic body.
- b) Steel structure shall be analyzed as a space frame work. However, in common trussed structures, the stress may be calculated as a plane, truss of which the members are frame in one plane, substituting the space framework, and furthermore, where the common truss has inclination, the truss may be the followings' all be taken into consideration:
- c) Where the inclination of the truss is not uniform, interaction between two inclinations.
- d) Other influence caused by construction of the plane trusses as a space framework.
- e) Neither the stress caused by dead load including ice coating load, nor the stress resulting from the combined load of dead load or seismic load shall exceed allowable stress of the materials specified in the Standard.

23.2.2.4 The stress analysis may be carried out by the means of electronic computer subject to applying the proven stress analysis program.

23.2.2.5 The bidder shall submit the tower line diagram with length and the foundation drawing signed by competent design team. BT reserved the right to ask the details of foundation information from the design team.

23.2.2.6 The bidder shall submit the weight of tower.

23.2.2.7 Design for Tower ladder should have enough length to grout on the ground.

23.2.3 Loads on Facility's Structure

23.2.3.1 Dead Load

Dead load means the dead weight of the antenna supporting structure and all other facility's structure, all appurtenances and other such items as antennas, which are to be mounted on the main supporting structure. Where required, dead weight of the ice, which is expected to coat on all members of the antenna supporting structure and all other facility's structure, the appurtenances, antenna, etc, shall be included in the dead load. At sites over 2,500 meters above sea level, antenna supporting structures antennas and all other facilities shall be considered for ice coating load. Unless otherwise specified, radius thickness of the ice coating and density of the ice may be assumed as 10 mm and 0.6 g / cu.cm respectively.

23.2.3.2 Wind Load

- a) Full calculation shall be taken in the wind load acting on the antenna supporting structure and all other facilities, the appurtenance and antenna, etc to be attached on the main supporting structure. The ice coating, if required, shall be included as a part of the projected area for locations over 2,500 meters above sea level.
- b) The combined effects of dead load and wind load shall be taken into calculation in the stress analysis so that the worst stress in all component part can be determined. Where height, direction, size and/or type of the antennas are not specified and they cannot be determined at the stage of structural calculation, these shall be so assumed that they cause the worst effects on the structure when wind load is calculated.
- c) Unless otherwise specified, any formulas, coefficients and factors required for calculation of the wind load shall be in accordance with the standard, or the results of tunnel test as an alternative of the standard.
- d) For the purpose of design and calculations, the wind speed shall be taken at 180 km / hour.

23.2.3.3 Seismic load.

- a) Where required to considered, the combined effect of dead load and seismic load shall be taken into the calculation.
- b) Combined effects of seismic load and wind load may not be taken into the calculation.
- c) The lateral seismic factor may be assumed as $k = 0.1$ from the 100 years probability value of 100 gal given in the maximum expected seismicity distribution map of the world published by the Building Research Institute (Ministry of Construction, Japan) or an equally renowned institute, for the calculation.

23.2.3.4 Soil Bearing Capacity

- a) Soil bearing capacity at all the sites is assumed as at least 10 tons/sq.m.

23.2.3.5 Transmission Loss of Telecommunication Network.

Radio transmission loss shall be as follows:

- a) Wind speed 90 km/h (25m/sec) = Radio transmission loss <3Db.
- b) Wind speed 150 km/h (42m/sec) = Radio transmission loss <20Db.

23.2.4 Tower Shape

- a) Each tower shall have a triangular or square cross section. The top section of each tower shall be parallel sided for not less than 5 meters with a triangular or square cross section of not less than 2.0 per side.

23.2.5 Distribution of load as per the height of the towers.

23.2.5.1 General

- a) The concrete work specified in this chapter consists of formwork, reinforcement, concreting, anchoring for concrete and other works necessary for the facilities to provide Application.

All the concrete to be used shall be batched as shown in Table 1. Load Distribution of 40 m Tower (Please refer the drawing as attached)

Table 1: Load Distribution of 40m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	40M 3Legged Angular Tower AGD-320	40M	Remote Radio Head	9	25	225
			Sectorial Antenna	9	27	243
			Microwave Antenna			
			1.2m dia	2	30	60
			0.6m dia	2	20	40
			Total Weight			568.00

Table 2: Load Distribution of 35m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	35M 3Legged Angular Tower AGD-320	35M	Remote Radio Head	9	25	225
			Sectorial Antenna	9	27	243
			Microwave Antenna			
			1.2m dia	2	30	60
			0.6m dia	2	20	40
			Total Weight			568.00

Table 3: Load Distribution of 30m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	30M 3Legged Angular Tower AGD-320	30M	Remote Radio Head	9	25	225
			Sectorial Antenna	9	27	243
			Microwave Antenna			
			1.2m dia	2	60	120
			0.6m dia	2	40	80
			Total Weight			568.00

Table 4: Load Distribution of 25m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	25M 3Legged Angular Tower AGD-320	25M	Remote Radio Head	6	25	150
			Sectorial Antenna	6	27	162
			Microwave Antenna			
			0.9m dia	2	25	50
			Total Weight			362.00

Table 5: Load Distribution of 20m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	20M 3Legged Angular Tower AGD-320	20M	Remote Radio Head	6	25	150
			Sectorial Antenna	6	27	162
			Microwave Antenna			

			0.6m dia	2	20	40
			Total Weight			352.00

Table 6: Load Distribution of 15m Tower (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	15M 3Legged Angular Tower AGD-320	15M	Remote Radio Head	6	25	150
			Sectorial Antenna	6	27	162
			Microwave Antenna			
			0.6m dia	2	20	40
			Total Weight			352.00

23.2.6 Twist, Sway and Displacement

23.2.6.1 Twists means horizontal angular displacement of the main supporting structure at each antenna mounting elevation from no wind load position to worst wind load position.

23.2.6.2 Sway means vertical angular displacement of the central vertical axis at each antenna mounting elevation from its no wind position to the worst wind load position, divided by each corresponding elevation.

23.2.6.3 Unless otherwise specified, twist, sway and displacement shall not exceed the following values:

- a) Twist : 1 deg.
- b) Sway : 1 deg.
- c) Displacement : 1/100

23.2.7 Earth works

23.2.7.1 General

23.2.7.1.1 Extent

- a) The earthwork specified in this chapter consists of excavation, grading filling, backfilling and related earthwork necessary to complete the facilities to be provided.

23.2.7.1.2 Planning

- a) Prior to commencement of the earthwork, the bidders shall submit to the Employer two (2) copies of planning drawings in which all the dimensions, procedures and methods

for excavation, cutting, filling and backfilling, are clarified.

23.2.7.2 Excavation

- 23.2.7.2.1 Excavation for all the foundations shall be executed either by mechanical facilities or by hand. However, the portion of a depth of at least 30 cm above the level of bottom of excavation shall carefully be executed by hand in order not to disturb or destroy the surface of the layer.
- 23.2.7.2.2 In the case where any part of the surface of excavation is disturbed or destroyed, tamping or substitution, such as cast-in- site plain concrete shall be carried out so as to make the part stronger than the natural condition.
- 23.2.7.2.3 To ensure safety at work, the contractor shall provide shoring, sheet piling or waling, if necessary. Shoring shall be removed as back filling progresses but only after confirming that banks are safe against collapse or carving on slopes.
- 23.2.7.2.4 The bidders shall completely remove all existing obstructions against the construction of the facilities.
- 23.2.7.2.5 All debris has to be cleared from the sites to the designated site identified by the local authority

23.2.7.3 Drainage

- 23.2.7.3.1 The bidders shall control the grading around the facilities to be provided so as to prevent water from running into the excavated areas and damaging the facilities. The bidders shall also maintain all pits and trenches where footings are to be placed, free of water at all times. Water pumps, wherever required, shall to be provided to keep the excavated spaces clear of water during the construction.

23.2.7.4 Backfilling for Structures

- 23.2.7.4.1 Before placing backfill, the bidders shall remove all debris subject to termite attack, rot, or corrosion, and all other deleterious materials from areas to be backfilled. The bidders shall deposit backfills in layers of not more than 30cm thick and compact each layer.

23.2.7.5 Site Grading

- 23.2.7.5.1 Rough grading of the site in the excavated and filled sections as well as the adjacent transition areas shall be reasonably smoothed and compacted and shall be free from irregular surface changes. The sub- grade shall be evenly sloped to provide drainage away from the facilities and in suitable directions at a grade of not less than 1%.

23.2.7.6 Concrete Works

Concrete are mixed at site.

23.2.7.6.1 Standards

- a) Unless otherwise specially specified. JIS, ASTM and BS standards shall be applied. Application of any other equivalent standard shall be notified to the employer for approval

23.2.7.7 Materials of forms

- 23.2.7.7.1 The forms shall be able to withstand loads that may be forced by concrete weight and pressure, vibration and shock during concreting works and shall not distort or warp to the poured concrete
- 23.2.7.7.2 The forms shall include all spacers, chairs, bolsters, ties and other devices necessary for properly placing, spacing, and fastening reinforcement in place
- 23.2.7.7.3 The formworks shall remain in position until the concrete gains adequate compressive strength as per the internationally accepted norms and practices.

23.2.7.8 Materials of Reinforcement

23.2.7.8.1 Reinforcing Bars.

- a) All the reinforcing bars shall to be hot rolled deformed bars in accordance with BS 4449, JIS G 3112, ASTM A615 or equivalent. The tensile requirements for deformed bars are as follows:

Yield Point : 3,000 kg/sq.cm or more

Tensile Strength : 4,900 – 6,300 kg/sq.cm

Elongation : 14 % or more.

23.2.7.8.2 Welded wire Meshes.

Welded wire meshes shall be 3.2 mm in diameter, spaced at 100mm by 100mm on centers.

23.2.7.8.3 Inspection of Reinforcement

The reinforcement bars shall be inspected by the Employer after the reinforcement bars has been placed prior to placing of concreting, whenever and wherever required.

23.2.7.8.4 Materials of Concrete

23.2.7.8.4.1 Cement

- a) Ordinary Portland cement to be used shall be declared to and approved by the Employer.
- b) Mechanical and physical tests for the cement shall be carried out by the bidders at his own expenses when required by the Employer.

23.2.7.8.4.2 Aggregates.

- a) Samples of aggregates to be used shall be submitted to the Employer for approval. The bidders shall ensure that only aggregates of approved quality are used for all concrete works.

23.2.7.8.4.3 Water.

- a) The water for mixing and curing shall be clean and free from earth, vegetation's, organic and inorganic impurities.

23.2.7.9 Quality of Concrete

23.2.7.9.1 Adequate mix ratios of cement, sand and aggregates shall be used to achieve the strength requirements specified.

23.2.7.9.2 The mix ratios of these materials shall be approved by the Employer.

23.2.7.9.3 The general requirements and types of Concrete are as follows:

	Type A	Type B
i) Cement, kg / cu.m of Concrete	270 or more	250 or more
ii) Design strength at 28 days	150	135
iii) Method of compacting concrete when placed	vibrate	vibrate

23.2.7.9.4 Type of Concrete

The types of concrete to be used for the purposes are stated in the table below:

Type of Concrete	Purpose
A	All the structural members
B	Leveling concrete under foundations and other non-structural components.

23.2.7.10 Depositing Concrete

23.2.7.10.1 The concrete shall be placed with the aid of mechanical vibrations applied directly to the concrete. No concreting works will be allowed without the use of vibrators.

23.2.7.10.2 The bidders shall ensure proper and complete curing of concrete irrespective of the availability of water at site to prevent rapid evaporation of moisture and to maintain concrete in a moist condition.

23.2.8 Structural Works

23.2.8.1 Materials

23.2.8.1.1 Structural Steel

- a) Standards: The structural steel shall be standardized products confirming to well-known and internationally accepted standards. The steel to be used shall not have any structural defects and shall not be obtrusively corroded.
- b) Shapes and Dimensions: Set of high strength bolts, nuts, washers and plates, confirming to renowned standards shall be used. The shapes and dimensions of the bolts and nuts shall be finishing grade “medium” precision grade “3rd class” of internationally accepted standards. The shape and dimension of steel plates, stainless steel plates and other related items shall also confirm to internationally accepted standards.

23.2.8.1.2 Welding Materials

- a) The electrode to be used for welding shall be standard products. Appropriate electrodes shall be selected for the type of steel to be welded.
- b) Welding materials other than those stipulated above shall be selected according to the method of welding to be employed.

23.2.8.1.3 Bolts Holes

- a) The diameter of bolt holes shall be larger 0.5 mm than the diameter of the bolt itself.
- b) Anchor bolts shall be secured by using two (2) nuts.
- c) For bolts, other than those mentioned above, and for those embedded in concrete proper precaution shall be taken to prevent nut loosening by using either double nuts or spring washers or any other acceptable methods.

23.2.8.2 Welding

23.2.8.2.1 General

This clause applies to the arc welding of structural steel elements.

- a) In-site welding shall be carried out after inspection of the steel fabrication an election.
- b) The welding shall be done only by qualified and experienced welders.

23.2.9 Product Inspection

23.2.9.1 In-shop inspection report of finished products shall be submitted to the Employer for approval.

23.2.9.2 The products shall be inspected by the employer after the in- shop inspection by the manufacturer.

23.2.9.3 Faulty portions shall be promptly rectified.

23.2.10 Painting of Structural Steel

23.2.10.1 All tower structural steel members shall not be painted. However, all structure steel including galvanized structural members shall receive two full coats of anti-corrosive paints conforming to internationally accepted standards, if so required by the Employer. The brand and color of the paint shall be approved by the Employer.

23.2.10.2 Bidder should quote painting cost separately

23.2.10.3 Surfaces to be embedded in or to come in the contact with the concrete shall not be painted.

23.2.11 Antenna Support Structure

23.2.11.1 General

23.2.11.1.1 The Antenna Supporting Structure to be constructed shall consist of foundation, main structure and appurtenances.

23.2.11.1.2 All steel materials including bolts and nuts shall conform to international standards. All materials of antenna supporting structure including other steel materials used in the structure shall be coated by hot-dip galvanizing after all fabrication works have been completed.

23.2.11.1.3 The antenna supporting structures shall be inspected by the Employer during the construction as well as after the completion of construction works.

23.2.11.1.4 A copy of final drawings and instructions shall be submitted to the Employer promptly after the completion of the antenna supporting structures for the Employer's record.

23.2.11.2 Antenna Mounting

23.2.11.2.1 Consistent with tower height, towers shall be arranged to support antennas at a number of different levels.

23.2.11.2.2 This distance may be altered slightly to fit in with the geometry of the tower bracing.

23.2.11.2.3 Each antenna mounting position shall be capable of being served by an access platform located approximately 1 meter below the center line of the Mounting platforms shall be provided for all antenna positions, which are to be utilized by the Bidder in meeting the radio system requirements. Mounting platforms are not required for unequipped antenna positions.

23.2.11.2.4 Antennas shall be mounted on mounting bars to be attached at each mounting level, at set specified vertical distance apart. This distance shall be specified by the Bidders, but should be typically of the order of 1.5 meters.

23.2.11.2.5 Three sectored GSM antennas shall be mounted on bars/pipes of 50mm-400mm in diameter and 3000mm in length. In addition, two similar bars/pipes shall be provided below the GSM antenna for mounting the radio antenna.

23.2.11.2.6 Appropriately sized holes shall be provided in the tower legs at each mounting level for mounting bars to be added as required for future radio systems.

23.2.11.2.7 Bidders shall allow for two pairs of holes per leg on each face at each mounting level.

23.2.11.3 Antenna and Remote radio unit Feeder Runway

23.2.11.3.1 Each tower shall be equipped with a straight, vertical antenna feeder runway extending from the ground to the top of each tower for the provision of coaxial cable and wave guide feeders as necessary. This runway shall have provision for future radio expansion of:

a) 10 cables -16mm Dia.

b) 10 cables/wave guides -28mm Dia.

23.2.11.3.2 For towers with a central runway, the lower end of the runway shall be set in a concrete foundation laid on a solid base. Typically this would consist of a concrete foundation block approximately 1.0m x 0.4m deep.

23.2.11.3.3 The Bidders shall include design details for a suitable sized antenna feeder gantry extending from the tower structure to the equipment building. This gantry shall be of sturdy construction utilizing galvanized steel members and offer some protection to the feeder cables in the event of flying debris in high winds. Feeder cables should preferably be laid on the outside of the gantry.

23.2.12 Platforms

23.2.12.1 Working platforms shall be provided to allow access to each antenna equipped for the initial installation specified in these bidding documents.

23.2.12.2 In addition rest platforms shall be provided on all towers where the vertical spacing between working platforms, or the lowest working platform and ground level, exceeds 15 meters. Rest platforms, where practicable, shall be provided at

levels, which coincide with the levels of the working platform for antenna mounting positions.

- 23.2.12.3 Platform checking shall be of expanded metal mesh, or similar construction, and shall be adequately supported on steel members of appropriate size.

23.2.13 Guard Rails

- 23.2.13.1 Platforms shall be provided with handrails at a height of approximately 1 meter above the decking, intermediate rails at approximately 0.5 meters above the decking and kick rails at the decking level

- 23.2.13.2 All rails shall consist of suitably sized rolled steel angle section.

- 23.2.13.3 Guardrails shall be provided on all platforms and shall be continuous around the outside perimeter and the runway opening of each platform and shall encompass the ladder and ladder guard so that free access to the ladder may be gained from the platforms.

- 23.2.13.4 Handrails on platforms shall not be structural members and shall be removable to facilitate the mounting of antennas.

23.2.14 Ladders

- 23.2.14.1 Steel ladders with ladder guards shall be provided from ground level to the highest working platform on each tower.

- 23.2.14.2 The ladder guard shall be so arranged that, at each antenna mounting level, a section may be removed to provide access to the future platform without having to cut the vertical strips.

- 23.2.14.3 Ladders shall, where practicable, continue for a distance of at least 1 meter above the upper surface of the platform that is served. The stiles shall not, however, project above the top of a tower.

- 23.2.14.4 Ladders, ladder guards and ladder support shall not infringe on the space reserved for antenna feeders.

- 23.2.14.5 Ladders shall be adequately supported to resist lateral movement.

23.2.15 Lightning Protection

- 23.2.15.1 Two lightning discharge rods of height approximately 1.2 meters shall be securely fixed to the top of each tower on diagonally opposite corners.

- 23.2.15.2 Each rod shall consist of a steel tube with four 13mm diameter rods of length 0.5 meter (approximately) welded to the top of the tube, disposed equally around the tube and splayed upwards at 45 degrees.

- 23.2.15.3 No separate earth conductor need be provided from the discharge rods to ground and it is necessary, therefore, that all bolted connections in the tower should be free from paint and reasonably clean at the time of assembly. This applies particularly to the point of the attachment of the discharge rods to the top of the tower.

- 23.2.15.4 Tower should have one LPI for each tower, the vendor should include accordingly and should inform employer for cross verification with power BOM.

23.2.16 Aviation light with its sensor

- 23.2.16.1 Aviation light with controlled sensor regulating time from 6PM to 6AM should be placed at top on the tower

23.2.17 Earthing

- 23.2.17.1 An earthing system, generally to the provisions of internationally accepted standard shall be provided at each tower. This shall consist of at least one radial earth strap extending from each tower leg, one loop encircling the tower and a separate loop encircling the equipment building.
- 23.2.17.2 Particular attention shall be paid to the bonding of the earthing strap to tower, runway, and gantry and building steelwork.
- 23.2.17.3 Earthing strap shall consist of pure copper of nominal dimensions 25mm x 3 mm.
- 23.2.17.4 The completed earth system shall have a resistance of less than 2 ohms, when measured with specific earth resistance-measuring instrument. Test result of the earth test should be

23.2.18 Inspections on Site

- 23.2.18.1 The Employer shall undertake an inspection on site as of the excavations for the tower foundations immediately before pouring of the concrete.
- 23.2.18.2 The Employer shall undertake an inspection on site as of samples of concrete in the foundations. The supplier shall supply sufficient quantity of testing cylinders for this purpose and shall bear the cost of such testing at and approved testing laboratory.
- 23.2.18.3 The Employer shall undertake an inspection on site of the steel work on delivery to site for damage, which may have occurred during transportation. Any damaged steelwork, particularly to galvanizing, shall be repaired by the supplier, to the satisfaction of the Employer, prior to erection of the steelwork.
- 23.2.18.4 The Employer shall undertake an inspection, on-site, of the completed installation for condition of the galvanizing, size of members, tightness of bolts and general workmanship.
- 23.2.18.5 The Supplier/contractor must inspect the goods prior to dispatch to ensure conformance to specification and/or any other provisions of the contract. BT reserves the right to inspect the goods for compliance with specifications and provisions of the contract at the factory before dispatching of the equipment at BT site. If, in the BT's opinion, the goods and/or services do not comply with the specification, the BT will inform the Supplier/contractor in writing. In such a case the Supplier/contractor shall take the necessary action to ensure compliance, liability for any additional cost incurred for rectifying

23.3 Specifications of Shelters

- 23.3.1 The bidder shall propose weatherproof prefabricated shelters for housing the Back Haul Radio and BTS equipment including power supply facilities.
- 23.3.2 The enclosures shall be mounted on concrete footings at least 3 feet above ground level. Proper steps shall be constructed below the entrance door of the prefabricated shelter for easy access.
- 23.3.3 The enclosures shall be, preferably, fabricated from high-grade plastic/PVC/other similar lightweight materials with metal sandwich. The materials used for the prefabricated enclosure shall be fire resistant and shall not corrode with age in outdoor installations.
- 23.3.4 The enclosure/shelter shall be designed to provide ventilation to the equipment while preventing moisture build-up inside.
- 23.3.5 It shall be extremely robust, corrosion resistant, high seismic resistance, wind & dust proof with thermal insulation.
- 23.3.6 It shall offer extruded aluminum alloy C-rails for a multipurpose user-friendly mounting arrangement for equipment racks and cable trays etc.
- 23.3.7 It shall have three way espagnolette-locking system in tandem with a cam profiled wedge (Which pulls the door leaf inside for proper closer) and EPDM gasket to make the door air and water tight to achieve an IP 54 level protection.
- 23.3.8 For sites above 2500m the roofing of the prefabricated shelters shall be so designed that accumulation of snow is kept at minimum.
- 23.3.9 The bidder shall submit the foundation with six pillars with three I-beam galvanized structure
- 23.3.10 The Supplier/contractor must inspect the goods prior to dispatch to ensure conformance to specification and/or any other provisions of the contract. BT reserves the right to inspect the goods for compliance with specifications and provisions of the contract at the factory before dispatching of the equipment at BT site. If, in the BT's opinion, the goods and/or services do not comply with the specification, the BT will inform the Supplier/contractor in writing. In such a case the Supplier/contractor shall take the necessary action to ensure compliance, liability for any additional cost incurred for rectifying.
- 23.3.11 Shelter to have 6 pillars with 3 I beam supporting the shelter.
- 23.3.12 Each shelter needs to have 1 AC and 1 ventilator, vendor should include accordingly and needs to verify with Power BOM.

23.3.1 Shelter Dimensions:

BTS sites shelter

- 23.3.1.1 Ext.: 3600x2600x2500 (LxWxH in mm),
- 23.3.1.2 Panel with Foam – 60 mm,
- 23.3.1.3 Material of Skins – 0.6mm x 0.6mm Precoated Steel,
- 23.3.1.4 Floor – Ply 18mm and PVC 2mm
- 23.3.1.5 Foundation – six pillars with 3 numbers of galvanized I-beam

Please Refer the drawings as attached (shelter drawing)

23.4 Specification of Monopoles

23.4.1 Structural Design

23.4.1.1 General

- 23.4.1.1.1 Unless otherwise specified, the antenna supporting structure shall be self-supporting type and foundation shall be of reinforced concrete.
- 23.4.1.1.2 Any stress of component of facilities, of steel, bolt, reinforcing bar and concrete shall not exceed allowable stress of material specified in the standard.
- 23.4.1.1.3 The design for steel structure shall be based on the following concept and assumption in case if the Monopole structure to be constructed:
- 23.4.1.1.4 Steel structure shall be regarded as an elastic body.
- 23.4.1.1.5 Neither the stress caused by dead load including ice coating load, nor the stress resulting from the combined load of dead load or seismic load shall exceed allowable stress of the materials specified in the Standard.
- 23.4.1.1.6 The stress analysis may be carried out by the means of electronic computer subject to applying the proven stress analysis program.
- 23.4.1.1.7 The bidder shall submit the Monopole line diagram with length and the foundation drawing signed by competent design team. BT reserved the right to ask the details of foundation information from the design team.
- 23.4.1.1.8 The bidder shall submit the weight of Monopole.
- 23.4.1.1.9 Steel ladders steps in nut bolts system should be provided.

23.4.2 Specification of Street lamp and Meter Box

Sl. No	Item	Item Description	Make
1	MCB	SPN 32 Amps	Havells/Anchor/Legrand/Schneider/Siemens
2	Energy Meter Box	Energy Meter Box with built in DIN Rail and provision for fixing of 2 nos of SPN MCBs (32 & 16 Amps) & 1 Phase Energy Meter (32 Amps) with the following details: 1.1 Material: CRCA 1.2 Surface Finish: Powder 1.3 Ingress Protection: IP65 Transparent Enclosure Coated 1.5 Cable Entry: Min 4 Nos with PG Type Cable Glands (entry from bottom) 1.6 Accessories: Stainless Steel Metal Cable Tie with screw to fix the box on the monopole tower 1.7	Hensel, Anchor, Havells, Mescab or equivalent
3	Warning Electrical Hazard Sticker	Warning Electrical Hazard Sticker with electrocution symbol for sticking at the outdoor monopole towers: dimension: L(cm) X B(cm): 20 cm X 10 cm	Any good quality

4	LED Street Lamp including lighting wires	80 W (10000 System Lumens) High Efficacy LED street lights with efficacy >110 lm/W Ease of Maintenance Top opening separate driver compartment for ease of maintenance Wide Voltage Operating Range 140 V - 270 V Wide temperature operating range -10 °C to +50 °C Ingress Protection: IP65	Havells/Anchor/Philips/Panasonic
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23.4.3 Loads on Facility’s Structure

23.4.3.1 Dead Load

Dead load means the dead weight of the antenna supporting structure and all other facility’s structure, all appurtenances and other such items as antennas, which are to be mounted on the main supporting structure. Where required, dead weight of the ice, which is expected to coat on all members of the antenna supporting structure and all other facility’s structure, the appurtenances, antenna, etc, shall be included in the dead load. At sites over 2,500 meters above sea level, antenna supporting structures antennas and all other facilities shall be considered for ice coating load. Unless otherwise specified, radius thickness of the ice coating and density of the ice may be assumed as 10 mm and 0.6 g / cu.cm respectively.

23.4.3.2 Wind Load

- a) Full calculation shall be taken in the wind load acting on the antenna supporting structure and all other facilities, the appurtenance and antenna, etc to be attached on the main supporting structure. The ice coating, if required, shall be included as a part of the projected area for locations over 2,500 meters above sea level.
- b) The combined effects of dead load and wind load shall be taken into calculation in the stress analysis so that the worst stress in all component part can be determined. Where height, direction, size and/or type of the antennas are not specified and they cannot be determined at the stage of structural calculation, these shall be so assumed that they cause the worst effects on the structure when wind load is calculated.
- c) Unless otherwise specified, any formulas, coefficients and factors required for calculation of the wind load shall be in accordance with the standard, or the results of tunnel test as an alternative of the standard.
- d) For the purpose of design and calculations, the wind speed shall be taken at 180 km / hour.

23.4.3.3 Seismic load.

- a) Where required to considered, the combined effect of dead load and seismic load shall be taken into the calculation.
- b) Combined effects of seismic load and wind load may not be taken into the calculation.

- c) The lateral seismic factor may be assumed as $k = 0.1$ from the 100 years probability value of 100 gal given in the maximum expected seismicity distribution map of the world published by the Building Research Institute (Ministry of Construction, Japan) or an equally renowned institute, for the calculation.

23.4.3.4 Soil Bearing Capacity

Soil bearing capacity at all the sites is assumed as at least 10 tons/sq.m.

23.4.3.5 Transmission Loss of Telecommunication Network.

Radio transmission loss shall be as follows:

- a) Wind speed 90 km/h (25m/sec) = Radio transmission loss <3Db.
- b) Wind speed 150 km/h (42m/sec) = Radio transmission loss <20Db.

23.4.4 Distribution of load as per the height of the Monopoles.

23.4.4.1 General

23.4.4.1.1 The concrete work specified in this chapter consists of formwork, reinforcement, concreting, anchoring for concrete and other works necessary for the facilities to provide Application.

Load Distribution of Monopole (Please refer the drawing as attached)

Table 7: Load Distribution of 15m Monopole for both slip and flange joint (Please refer the drawing as attached)

SL No	Tower Type	Tower Height	Antennas & Radios	Quantity	Weight/Unit (Kg)	Total Weight (Kg)
1	15M Monopole AGD-320	15M	Remote Radio Head	6	25	150
			Outdoor BBU	2	25	50
			Outdoor Battery	2	35	70
			Power supply unit	2	10	20
			Sectorial Antenna	6	20	120
			Microwave Antenna			
			0.6m dia	2	20	40
			Total Weight			450.00

23.4.4.2 Twist, Sway and Displacement

23.4.4.2.1 Twists means horizontal angular displacement of the main supporting structure at each antenna mounting elevation from no wind load position to worst wind load position.

23.4.4.2.2 Sway means vertical angular displacement of the central vertical axis at each antenna mounting elevation from its no wind position to the worst wind load position, divided by each corresponding elevation.

23.4.4.2.3 Unless otherwise specified, twist, sway and displacement shall not exceed the following values:

- a) Twist : 1 deg.
- b) Sway : 1 deg.
- c) Displacement : 1/100

23.4.5 Earth works

23.4.5.1 General

a) Extent

The earthwork specified in this chapter consists of excavation, grading filling, backfilling and related earthwork necessary to complete the facilities to be provided.

b) Planning

Prior to commencement of the earthwork, the bidders shall submit to the Employer two (2) copies of planning drawings in which all the dimensions, procedures and methods for excavation, cutting, filling and backfilling, are clarified.

23.4.5.2 Excavation

a) Excavation for all the foundations shall be executed either by mechanical facilities or by hand. However, the portion of a depth of at least 30 cm above the level of bottom of excavation shall carefully be executed by hand in order not to disturb or destroy the surface of the layer.

b) In the case where any part of the surface of excavation is disturbed or destroyed, tamping or substitution, such as cast-in- site plain concrete shall be carried out so as to make the part stronger than the natural condition.

c) To ensure safety at work, the contractor shall provide shoring, sheet piling or waling, if necessary. Shoring shall be removed as back filling progresses but only after confirming that banks are safe against collapse or carving on slopes.

d) The bidders shall completely remove all existing obstructions against the construction of the facilities.

e) All debris has to be cleared from the sites to the designated site identified by the local authority

23.4.5.3 Drainage

- a) The bidders shall control the grading around the facilities to be provided so as to prevent water from running into the excavated areas and damaging the facilities. The bidders shall also maintain all pits and trenches where footings are to be placed, free of water at all times. Water pumps, wherever required, shall to be provided to keep the excavated spaces clear of water during the construction.

23.4.5.4 Backfilling for Structures

- a) Before placing backfill, the bidders shall remove all debris subject to termite attack, rot, or corrosion, and all other deleterious materials from areas to be backfilled. The bidders shall deposit backfills in layers of not more than 30cm thick and compact each layer.

23.4.5.5 Site Grading

- a) Rough grading of the site in the excavated and filled sections as well as the adjacent transition areas shall be reasonably smoothed and compacted and shall be free from irregular surface changes. The sub- grade shall be evenly sloped to provide drainage away from the facilities and in suitable directions at a grade of not less than 1%.

23.4.5.6 **Concrete Works**

Concrete are mixed at site.

- a) Standards

Unless otherwise specially specified. JIS, ASTM and BS standards shall be applied. Application of any other equivalent standard shall be notified to the employer for approval

23.4.5.7 Materials of forms

- a) The forms shall be able to withstand loads that may be forced by concrete weight and pressure, vibration and shock during concreting works and shall not distort or warp to the poured concrete
- b) The forms shall include all spacers, chairs, bolsters, ties and other devices necessary for properly placing, spacing, and fastening reinforcement in place
- c) The formworks shall remain in position until the concrete gains adequate compressive strength as per the internationally accepted norms and practices.

23.4.5.8 Materials of Reinforcement

- a) Reinforcing Bars.

All the reinforcing bars shall to be hot rolled deformed bars in accordance with BS 4449, JIS G 3112, ASTM A615 or equivalent. The tensile requirements for deformed bars are as follows:

Yield Point : 3,000 kg/sq.cm or more

Tensile Strength : 4,900 – 6,300 kg/sq.cm

Elongation : 14 % or more.

b) Welded wire Meshes.

Welded wire meshes shall be 3.2 mm in diameter, spaced at 100mm by 100mm on centers.

23.4.5.9 Inspection of Reinforcement

a) The reinforcement bars shall be inspected by the Employer after the reinforcement bars has been placed prior to placing of concreting, whenever and wherever required.

23.4.5.10 Materials of Concrete

23.4.5.10.1 Cement

- a) Ordinary Portland cement to be used shall be declared to and approved by the Employer.
- b) Mechanical and physical tests for the cement shall be carried out by the bidders at his own expenses when required by the Employer.

23.4.5.10.2 Aggregates.

a) Samples of aggregates to be used shall be submitted to the Employer for approval. The bidders shall ensure that only aggregates of approved quality are used for all concrete works.

23.4.5.10.3 Water.

a) The water for mixing and curing shall be clean and free from earth, vegetation's, organic and inorganic impurities.

23.4.5.11 Quality of Concrete

23.4.5.11.1 Adequate mix ratios of cement, sand and aggregates shall be used to achieve the strength requirements specified.

23.4.5.11.2 The mix ratios of these materials shall be approved by the Employer.

23.4.5.11.3 The general requirements and types of Concrete are as follows:

	Type A	Type B
i) Cement, kg / cu.m of Concrete	270 or more	250 or more
ii) Design strength at 28 days	150	135
iii) Method of compacting concrete when placed	vibrate	vibrate

23.4.5.11.4 Type of Concrete

The types of concrete to be used for the purposes are stated in the table below:

Type of Concrete	Purpose

A	All the structural members
B	Leveling concrete under foundations and other non-structural components.

23.4.5.12 Depositing Concrete

- a) The concrete shall be placed with the aid of mechanical vibrations applied directly to the concrete.
- b) The bidders shall ensure proper and complete curing of concrete irrespective of the availability of water at site to prevent rapid evaporation of moisture and to maintain concrete in a moist condition.

23.4.6 Structural Works

23.4.6.1 Materials

23.4.5.11.5 Structural Steel

- a) Standards: The structural steel shall be standardized products confirming to well-known and internationally accepted standards. The steel to be used shall not have any structural defects and shall not be obtrusively corroded.

23.4.5.11.6 Shapes and Dimensions.

- a) Set of high strength bolts, nuts, washers and plates, confirming to renowned standards shall be used. The shapes and dimensions of the bolts and nuts shall be finishing grade “medium” precision grade “3rd class” of internationally accepted standards. The shape and dimension of steel plates, stainless steel plates and other related items shall also confirm to internationally accepted standards.

23.4.6.2 Bolts Holes

- 23.4.6.2.1 The diameter of bolt holes shall be larger 0.5 mm than the diameter of the bolt itself.
- 23.4.6.2.2 Anchor bolts shall be secured by using two (2) nuts.
- 23.4.6.2.3 For bolts, other than those mentioned above, and for those embedded in concrete proper precaution shall be taken to prevent nut loosening by using either double nuts or spring washers or any other acceptable methods.

23.4.7 Product Inspection

- 23.4.7.1 In-shop inspection report of finished products shall be submitted to the Employer for approval.
- 23.4.7.2 The products shall be inspected by the employer after the in- shop inspection by the manufacturer.
- 23.4.7.3 Faulty portions shall be promptly rectified.

23.4.8 Painting of Structural Steel

23.4.8.1 All tower structural steel members shall not be painted. However, all structure steel including galvanized structural members shall receive two full coats of anti-corrosive paints conforming to internationally accepted standards, if so required by the Employer.

23.4.9 Antenna Support Structure

23.4.9.1 General

23.4.9.1.1 The Antenna Supporting Structure to be constructed shall consist of foundation, main structure and appurtenances.

23.4.9.1.2 All steel materials including bolts and nuts shall conform to international standards. All materials of antenna supporting structure including other steel materials used in the structure shall be coated by hot-dip galvanizing after all fabrication works have been completed.

23.4.9.1.3 The antenna supporting structures shall be inspected by the Employer during the construction as well as after the completion of construction works.

23.4.9.2 Antenna Mounting

23.4.9.2.1 Antennas shall be mounted on mounting bars to be attached at each mounting level, at set specified vertical distance apart. This distance shall be specified by the Bidders, but should be typically of the order of 1.5 meters.

23.4.9.2.2 Three sectored GSM antennas shall be mounted on bars/pipes of 50mm-400mm in diameter and 1500-2000mm in length.

23.4.10 Lightning Protection

23.4.10.1 One lightning discharge rods of height approximately 1.2 meters shall be securely fixed to the top of each monopole.

23.4.10.2 Employer will inform the vendor, if there is any requirement of LPI and accordingly the monopole needs to be designed.

23.4.11 Aviation light with its sensor

23.4.11.1 Aviation light with controlled sensor regulating time from 6PM to 6AM should be placed at top on the Monopole for monopole height more than 25m and the employer will specify if required for other monopoles.

23.4.12 Earthing

23.4.12.1 An earthing system, generally to the provisions of internationally accepted standard shall be provided at each Monopole.

23.4.12.2 Earthing strap shall consist of pure copper of nominal dimensions 25mm x 3 mm.

23.4.12.3 The completed earth system shall have a resistance of less than 2 ohms, when measured with specific earth resistance-measuring instrument. Test result of the earth test should be submitted to employer

23.4.13 Inspections on Site

- 23.4.13.1 The Employer shall undertake an inspection on site as of the excavations for the tower foundations immediately before pouring of the concrete.
- 23.4.13.2 The Employer shall undertake an inspection on site as of samples of concrete in the foundations. The supplier shall supply sufficient quantity of testing cylinders for this purpose and shall bear the cost of such testing at and approved testing laboratory.
- 23.4.13.3 The Employer shall undertake an inspection on site of the steel work on delivery to site for damage, which may have occurred during transportation. Any damaged steelwork, particularly to galvanizing, shall be repaired by the supplier, to the satisfaction of the Employer, prior to erection of the steelwork.
- 23.4.13.4 The Employer shall undertake an inspection, on-site, of the completed installation for condition of the galvanizing, size of members, tightness of bolts and general workmanship.
- 23.4.13.5 The Supplier/contractor must inspect the goods prior to dispatch to ensure conformance to specification and/or any other provisions of the contract. BT reserves the right to inspect the goods for compliance with specifications and provisions of the contract at the factory before dispatching of the equipment at BT site. If, in the BT's opinion, the goods and/or services do not comply with the specification, the BT will inform the Supplier/contractor in writing. In such a case the Supplier/contractor shall take the necessary action to ensure compliance, liability for any additional cost incurred for rectifying.

23.5 Specification of Diesel Engine Generator

Please refer the attached drawing

23.5.1 Natural aspirated industrial diesel engine with superior efficiency and economy

- 23.5.1.1 Integral vibration isolation eliminates the need for under-unit vibration spring isolators
- 23.5.1.2 Advanced Digital Controller (ADC) with 3 auto crank cycles
- 23.5.1.3 Alternator features
 - a) Alternator meets Indian and international standards
- 23.5.1.4 Self-ventilated and dirtproof of IP23 construction
- 23.5.1.5 Superior voltage waveform by 2/3 pitch wound stator
- 23.5.1.6 Sustained short circuit current of up to 300% of the rated current for 3 seconds
- 23.5.1.7 Silencer located inside canopy
- 23.5.1.8 On field convertibility from manual.

23.5.2 AMF Standard Features

- 23.5.2.1 Engine coupled, skid mounted alternator
- 23.5.2.2 Single - bearing alternator with insulation Class H
- 23.5.2.3 Unit mounted radiator with 50°C ambient temperature
- 23.5.2.4 Base frame mounted fuel tank with minimum 8 hrs running capacity
- 23.5.2.5 Dry type air filter

- 23.5.2.6 DG circuit breaker
- 23.5.2.7 Electric start with battery
- 23.5.2.8 Fuel water separator
- 23.5.2.9 Conveniently located fuel level indicator
- 23.5.2.10 Exhaust tail pipe as standard scope of supply
- 23.5.2.11 Weather proof enclosure to withstand harsh climate
- 23.5.2.12 All routine service points on one side of canopy
- 23.5.2.13 Four-point bottom lifting

23.5.3 Conformance Standards

- 23.5.3.1 ISO 3046
- 23.5.3.2 BS 5514
- 23.5.3.3 ISO 8528
- 23.5.3.4 IS 4722
- 23.5.3.5 IEC 34
- 23.5.3.6 BS 5000 (Part 99)
- 23.5.3.7 IS: 13364 (Part 1&2)

23.5.4 Prime Power Ratings:

Prime power ratings apply to installations where utility power is unavailable or unreliable. At varying load, the number of generators set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528/1, overload power in accordance with ISO-3046/1 and BS 5514. For limited running time and base load ratings, consult the factory. Obtain the technical information bulletin (TIB-101) on ratings guidelines for the complete ratings definitions.

23.5.5 Control panel

- 23.5.5.1 White powder coated control panel manufactured with CRCA sheet;
- 23.5.5.2 Control Panel is having following Features:
 - a) MCB of suitable rating with short circuit protection
 - b) Controller which displays voltage, current, KW, PF, Frequency, KWh.
 - c) Indicating lamps for “Load On” and “Set Running”
 - d) Current transformers of suitable ratings
 - e) Copper cables of suitable capacity with incoming and Outgoing terminations
 - f) Control fuses duly wired and ferruled
 - g) Power cables: Uninyvin copper conductor cables between Alternator & Control panel inside the canopy. Document: Operation Manual. General maintenance & installation Guideline and Foundation Drawing Parts manual

23.5.6 Engine Specifications of 20KVA DEG

Sl No.	Specifications	20 kVA
1	Engine: model, type	G20-II, Natural aspiration
2	No. of cylinders	3
3	Cylinder arrangement	Inline
4	Displacement, L (cu. in.)	2.15 (131.2)
5	Bore and stroke, mm (in.)	91 x 110 (3.58 x 4.33)
6	Compression ratio	17.5:1
7	Governor: type, Class	Mechanical, Class A2
8	Frequency regulation, steady state	ISO 8528 G2
9	Air cleaner type, Qty	Dry, 1
10	Unit-mounted radiator ambient temperature °C (°F)	50 (122)
11	Max. power kWm (BHP) @ rated speed (rpm)	19 (25) @ 1500
Diesel Fuel Consumption		
1	100% Load (Lph)	5.3
2	75% Load (Lph)	4
Lube Oil Consumption		
1	100% load	0.1 % of SFC
Fuel System		
1	Fuel prime pump	Mechanical
2	Fuel filter : Type, Qty	Combo fuel filter, 1
3	Recommended fuel	HSD
4	Fuel tank capacity, attached with DG	90 Litre
5	Fuel filter change period	Initial - 100 hrs / 3 months, Subsequent 500 hrs / 6 months whichever is earlier
Lubrication System		
1	System type	Forced Lubrication
2	Lube oil type	20/40W Oil
3	Oil pan capacity with filter, L	6
4	Oil filter: Quantity, Type	2, spin on & by-pass
5	Oil and oil filter change period	Initial - 100 hrs / 3 months, Subsequent 500 hrs / 6 months whichever is earlier
Exhaust System		
1	Maximum allowable back pressure, KPa (in.Hg)	4 (1.18)
2	Exhaust outlet size at engine hookup, mm (in)	50 (1.97)
3	Silencer Type, Quantity	Residential, 1
4	Exhaust temperature at rated kW, dry exhaust, °C (°F)	600 (1112)
Cooling System		
1	Ambient temperature, °C (°F)	50 (122)
2	Coolant capacity including engine, L (gal)	10.9 (2.9)
3	Water pump type	Impeller

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4	Fan diameter, including blades, mm (in.)	406.5 (16)
Engine Electrical System (Option-1)		
1	Starter Motor rated voltage VDC	12 V
2	Battery charging alternator	12 V, 35 Amp
3	Ground (negative/positive)	Negative
4	Battery type- Amp/hour Quantity	Flooded type, Maintenance free 90 1
5	Battery voltage, VDC	12
Engine Electrical System (Option-2)		
1	DG Cranking unit (For DG starting)	12VDC, Cranking unit in place of 12V DC external battery
Alternator Specifications		
Specifications		20 kVA
1	Type	4 Pole
2	Exciter type	Brushless
3	Voltage regulator	AVR SR-7/3
4	Insulation -- Material -- Temperature rise, Prime	Class H 125°C
5	Bearing: Quantity, Type	1, Sealed
6	Coupling	Flexible disk
7	Voltage regulation	+/-1%
8	Excitation	Self-excitation
9	Frequency, Fixed, Hz	50
10	Short circuit ratio	0.365
11	Full load current - 3 Phase, Full load current -1 Phase	28 87
12	Prime at 125° C, kVA	20

23.5.7 Advanced Digital Controller

23.5.7.1 Standard Features

- a) Master switch: Control On/Off
- b) Event Log
- c) Remote two-wire start/stop capability
- d) One-source responsibility for generating system & accessories
- e) Automatic start with programmed cranking cycle
- f) Field software upgrade possibility
- g) Operating temperature: -20°C to 70°C (-4°F to 158°F)
- h) Storage temperature: -20°C to 70°C (-4°F to 158°F)
- i) Humidity: 0-95% condensing
- j) Control Panel
- k) Alternator to control panel connection with copper cable only MCCB/MCB details: with short circuit and overload protection. Output copper cable size (Sq. mm): 1 run/ph. Microprocessor based AMF control panel capable of extending Remote monitoring system GPRS/EDGE/WCDMA/LTE based generator for remote monitoring system.



	20 kVA phase
Output copper cable size (Sq. mm): 1 run/ph	35

23.5.8 Controller Information

LCD Display	LCD Display Faults	Display Warnings	Optional Accessories	Power Requirements
Runtime hours	High engine temperature	Low battery voltage	Battery charger 12 V	6 to 36 VDC with fuse protection
Engine speed	Low oil pressure	High battery voltage	Mains sensing relay	250 mA @ 12 VDC
Power factor KVA _r	Overspeed / under speed	Low fuel level	Earth leakage protection	125 mA @ 24 VDC
Current	Over and under voltage	Maintenance alarm	VAF meter (multifunction)	
Voltage	Over and under frequency		kW-hr display	
Frequency	E-stop			
Engine temperature	Auxiliary fault			
Engine oil pressure	Low fuel level			
Battery voltage	Over load current			
Kilowatt & kVA	Phase reversal			
Fuel level (digital I/P)				

23.5.7.2 Automatic Mains Failure (AMF)

- a) AMF capacity should be as per the BOQ.
- b) When the AC mains power fails or deviates from the specified voltage limit, the standby diesel engine generator shall start automatically take over the load after the specified voltage is generated.
- c) When the AC mains power has recovered from the failure or has been resorted to normal conditions, the load shall be transferred back to the AC mains supply and the standby engine generator shall stop automatically.
- d) The start/stop control and load change over shall be possible by manual operation also.
- e) When any of the following trouble occurs, the diesel engine generator shall stop immediately and shall generate the alarm.
- f) Abnormal output voltage
- g) Excessive output current
- h) Over speed Fire / SmokeLow lubricant oil pressure
- i) Low fuel
- j) Failure of starting of diesel engine generator after 3 consecutive attempts.
- k) An emergency stop button shall be provided to shut down the generator. Upon

operation all generator control function shall be locked out so that it cannot be started until manually reset.

- l) An hour counter shall be provided to monitor the generator hours run. It shall be calibrated to read up to 99,999 hrs.
- m) The control panel shall have the facility to start / stop the Genset manually in manual mode.
- n) On receipt of the stop signal the Genset shall be allowed to run for a cooling down period. Once the engine has shut down, the panel should restore itself to a state of readiness to respond to any new start-up operation automatically without the necessity of any manual resetting.
- o) AMF should have the facility to activate Cold Start facility.
- p) A constant potential, current limited type battery charger shall be provided. It shall have a nominal input 230V +/- 10% and output of 13.5-volt DC and should be installed inside the AMF Panel. The rating shall be minimum 10 amps. Suitable un-armoured multi strand copper cables from AMF to both Battery shall be provided by the bidder.
- q) Metering shall be provided to monitor the voltage, current, frequency, Power Factor and Output Power (KVA and KW) of the Mains and Diesel Generator output.
- r) Engine Protection:
 - i. Mechanical Protection of the Engine: Low Lubricating Oil Pressure (LLOP) High Engine Temperature (HCT) Low Fuel Level
 - ii. Electrical Protection of Engine: Over Voltage & Under Voltage Protection and Over Load
- s) Remote Start / Stop: AMF should have facility to start /stop the engine from central server.
- t) Remote Monitoring: System should have the following Modbus data on RS485 for Mains & DG Parameter with DG Alarm data for monitoring from Central Server.

Sl No	Description	Modbus Address	Range
Parameters			
1	Mains Voltage	1061	0 to 720
2	Mains Frequency	1065	0 to 70
3	DG Voltage	1033	0 to 720
4	DG Frequency	1031	0 to 70
5	DG Power Factor	1555	-1 to +1
6	Load Current	1046	0 to 99999
7	DG Battery Voltage	1029	0 to 40
8	DG Fuel Level	1027	0 to 130
9	Engine Temperature	1025	-50 to 200
10	Engine Oil Pressure	1024	0 to 10000
11	Engine Speed	1030	0 to 6000
12	DG Run Hour	1799	0 to 4.29 x 10 ⁹ sec
13	DG Maintenance Due	1837	-2.14 x 10 ⁹ to +2.14 x 10 ⁹

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DG Alarms			
1	Emergency Stop	39426	0011 0000 0000 0000
2	Low Oil Pressure	39426	0000 0011 0000 0000
3	High Engine Temperature	39426	0000 0000 0010 0000
4	Engine Under Speed	39427	0011 0000 0000 0000
5	Engine Over Speed	39427	0000 0011 0000 0000
6	DG Low Frequency	39427	0000 0000 0010 0000
7	DG High Frequency	39427	0000 0000 0000 0010
8	DG Low Voltage	39428	0010 0000 0000 0000
9	DG High Voltage	39428	0000 0010 0000 0000
10	DG Low Battery	39428	0000 0000 0010 0000
11	DG High Battery	39428	0000 0000 0000 0010
12	DG Fail to Stop	39429	0000 0000 0010 0000
13	DG Fail to Start	39429	0000 0010 0000 0000
14	DG High Current	39431	0011 0000 0000 0000
15	Low Fuel Level	39435	0000 0011 0000 0000

	Compliance	
SI No.	Specifications	20 kVA
1	As per ISO 8178-5 mode cycle (Engine emission)	CPCB-II compliant
2	Noise level measured at 1 meter distance	< 75 dB (A)
	Dimensions and weight	
	Specifications	20 kVA
1	Overall Size, L x W x H (mm)	2000 x 950 x 1250
2	Weight, dry, max (kg) with its base frame galvanized	770-800Max
3	External Tank (Litres) should be	300