

**March 2025**

**THE REPUBLIC OF GUYANA**

Annex 1: WIND POWER PLANT FOR LEGUAN ISLAND

(Scope of Works for Implementation)



**Submission**

Guyana Energy Agency (GEA)

**Scope of Works for Implementation**

##### **Preamble**

Guyana's Low Carbon Development Strategy promotes use of clean and renewable energy. The Government of Guyana (GoG) is pursuing a significant increase in renewable energy technologies to generate electricity with the aim of reducing fossil fuel consumption. Leguan is an island situated mouth on the Atlantic Ocean in the Essequibo River. At present, Leguan island is powered using three diesel generators of installed capacity 1.23 MW (3x 410kW) and it is operated by the electrical utility, Guyana Power and Light Inc. (GPL). The peak demand and annual generation as of 2023 are 0.43 MW and 2,500 MWh respectively. GoG is installing a solar PV power plant (600 kWp) with the battery storage system of 1200 kWh which is expected to generate over 850 MWh of electricity annually (equivalent to about 35% of present energy demand). Further to enhance renewable energy integration, this wind power plant 500 kW (± 50 kW) is being advanced.

GEA intends to get the job executed starting from design, engineering, manufacture, supply, erection, testing commissioning and handover after synchronization with the existing grid and operation and maintenance of the Wind power plant, initially for one year, including 12 months of guarantee/warranty period excluding two months of stabilization period. The land has been already identified by GEA and the site feasibility study has already been completed.

##### **Language**

Contractor is required to furnish all required information and documents in the English language.

##### **Scope of supply/work and the technical requirements of the items**

* **Land**: The land for the wind power plant is already identified by GEA. The Ownership of the land will be with GPL unconditionally.
* **Wind Power Plant (WPP)**: Detailed Design, Micrositing, Engineering, Inspection, Testing, Expediting & Supply of Materials/Equipment, Transportation to Site, Erection/Installation, Construction, Pre-Commissioning, Performance Testing and Commissioning of 0.5 MW (±50 kW) Wind Power plant with all interfacing equipment for feeding the Leguan grid at a suitable Point of Interconnection in Leguan.
* **Statutory Approvals:** GEA has planned to install WTGs under the enhanced renewable energy for captive use of power in the island. GEA will obtain all no objection/ Approvals. The contractor will also be required to assist, follow up and finalize any other statutory approvals required for completion of this project. The charges for statutory approvals to be paid to Government agencies like NDC, EPA, Forest Department, Sea Defence, etc. would be borne by GEA during project implementation. Inter phasing with the local grid, contractor need to coordinate GPL. It is, however, the responsibility of the contractor to get all the related paper work, documentation done and finalize the statutory approval/registration.
* **Wind Mast:** It is already established by GEA with the sensor heights being at 20 and 30 meters respectively.
* **Training of GEA and GPL Officials:** GEA intends to train officials viz. Officers and Engineers in getting acquainted with the various equipment’s that form part of the Wind Power Plant, its testing, assessing performance, monitoring the performance during erection, installation and commissioning as well as during O&M period.

The training period envisaged by GEA is as follows:

1. Officers: Maximum of 6 officers for 7 working days at the principal’s works.
2. Engineers: Maximum of 6 engineers for 7 working days at the Principal’s works.

The entire cost for training including, transportation, accommodation etc should be borne by the Contractor.

* **Insurance:** Adequate insurance coverage during EPC *(Engineering, Procurement and Construction)* is in the scope of works of the contractor.
* **O&M :** The system is to be Operated & Maintained by the contractor for a period of one year including 12 months of guarantee/warranty period excluding two months of stabilization period from the date of commissioning. The O&M offer should be comprehensive. Cost of all spares and consumables, equipment, instruments & services, (Preventive & Breakdown) to take care of maintenance, has to be listed, provided and borne by the contractor during the O&M period. The quoted price shall be inclusive of all the cost for travel, stay, incidental expenses etc of contractor’s personals. The prices for O&M shall have to be offered along with the price offer and separated for ease of assessment.

The period of comprehensive operation and maintenance contract may be extended further by GPL on mutually agreed terms and conditions.

##### **Detailed Specification/Description:**

* 1. **Land**

The requirement of land for WPP is elaborated in this section.

1. The land is available with GEA at Leguan and its close to the site of upcoming Solar PV power plant.
2. The site coordinates are:

* Latitude: 6°56'15.28"N, Longitude: 58°21'47.95"W
* Latitude: 6°56'7.77"N, Longitude: 58°21'53.52"W

1. An image and conceptual layout of the site can be found in the figure below.

Aerial view of a land with a river

Description automatically generated with medium confidence

Figure 1: Aerial image of the proposed site.

1. Development, design and construction of all civil works which inter-alia includes:
   * + 1. Micro-siting.
       2. Conducting contour survey, site development including soil test, roughness for design and laying foundation for the WTGs.
       3. Marking of wind power project site.
       4. Site clearance and constructing approach roads for movement of materials required for the work and establishing parking area on the site and control room for WTGs (Individual / Common) with tubular towers along with design & it's foundation laying etc.
       5. Any other site development work necessary for setting up of the Wind Power Plant.
       6. Suitable arrangement of water to be ensured to cater to the day-to-day requirement of drinking water and other needs of wind power plant during O&M period by the contractor.
       7. Construction of control room of adequate area, to collect all relevant data regarding wind speed, energy and electrical parameters which are measured, stored on site and ready to transmit to other GPL locations.

If the contractor does not consider the Central Monitoring and Control System (CMCS) as supply item for the wind farm and wish to offer the service of Existing CMCS in the vicinity as common facility (like Solar PV farm) then the service charges have to be indicated and included in the O&M contract price.

No charges shall be payable separately against this for supply of material.

* 1. **Technical specification for WTG and associated equipment of WPP (wind power plant)**
     1. General:

1. **Micro-siting Report**: Based on furnished monitored data micro siting report, models and all relevant calculations are to be prepared. The following to be furnished:

* Detailed Procedure for Power Curve Guarantee along with the offer.
* Certified copy of Type Test Certificates.
* Validity of certificates shall be till the completion of Performance Guarantee period (10 years) after WTGs stabilization period.
* Wind Flow Model (preferable CFD Model)

1. Design, engineering, manufacture, and supply at site of suitable voltage, 60 Hz upwind/down wind, horizontal axis Wind Turbine Generators (2 X 250 kW) in the range of 0.5 MW (±50 kW) with accessories as may be required for erection, commissioning and successful continuous operation Wind-Power plant with all interfacing equipment for feeding Leguan grid at a suitable location. The WTGs shall be equipped with current limiting devices and capacitors/power electronic reactive power compensating equipment so as to maintain power factor as desired.
2. Design and construction of towers including foundation for WTGs.
3. Internal lines between WTGs, 13.8 kV circuit breakers and connected work at the place of interfacing with inter connections and evacuation system.

* Grid interfacing, including transformer, panels, monitoring device, or to provide indoor / outdoor type 13.8 kV Vacuum Circuit Breaker (VCB) and indoor / outdoor Control & Relay Panel (CRP) protection equipment, metering equipment, Internal lines for the evacuation point of the wind power plant to the nearest grid sub-station.
* The contractor will install energy meters for the export of electricity to the grid and recording import of the electricity from the grid.

1. The contractor shall include for the construction of a control room of adequate area, if required and make provision for Centralized Monitoring and Control System (CMCS) along with SCADA and synchronize the system with the exiting SCADA which is integrated for the Solar plant.
2. Laying of appropriate evacuation system for inter connection with the grid etc.
3. All items shall be carefully inspected and tested during manufacture and prior to dispatch in accordance with the standard practice of the manufacturer and the applicable standards as per inspection and testing. These certificates in triplicate shall be supplied before the dispatch of the equipment.
   * 1. Micrositing
4. **Annual Energy Production (AEP)** - Supplier/contractor shall perform the relevant engineering studies in accordance with standard wind energy practices to estimate the annual energy production from the WTGs offered using the Wind data - speed and direction or the wind potential at two levels 20 m and 30m – supplied along with the tender document.
5. The contractor shall submit the, "Micrositing Report” (include WASP or any other equivalent model used in the industry) with the following inputs in soft copy:

The maximum acceptable distance between proposed wind power plant (last turbine) and *reference* wind mast will be 8 km for uniform terrain and 3 km for complex terrain.

1. Certified Power Curve and Thrust curve of the proposed machine.
2. Exact positioning (coordinates) of each WTG Google earth map.
3. Details of Energy loss factors considered by the contractor in arriving at net estimated generation viz."

* Machine Availability
* Grid Availability
* In addition to above contractor shall clearly indicate various correction factors like Air Density etc.

1. Contractor to submit a detailed Procedure for Power Curve Guarantee as part of the design report (IEC61400-12-1).
2. Contractor shall submit certified copy of Type Test Certificates. Validity of certificates shall be till the completion of Performance Guarantee period.
3. It is mandatory that contractor stand by the Type Test Certificates and data submitted (IEC61400-22:2010 and IEC 61400-1 Edition 3.1 dated 2014-04 Class S).
   * 1. Wind turbine generators (WTGs)
4. **WTG Type**

The WTG offered shall be of 0.225 MW rating and above. The total capacity of the Wind Power Plant will be 500 kW (±50 kW) utilizing two WTGs. The WTG shall be of the type given below:

* Upwind/ down wind.
* Horizontal axis with active yawing.
* 3- bladed type rotor.
* Grid compatible.
* Stall regulated, active stall and pitch regulated.
* Tubular steel tower.

1. **General Requirements**

* The type of WTGs offered shall be of proven design, identical, commercially available and grid connected type.
* Type of WTG offered must have been in successful operation for a period of five year as on date of submission of offer. Detailed of such sites to be furnished.
* The WTG offered shall be type approved by a certification agency as per IEC standards.
* The WTGs offered shall be fitted with components as specified in the Certificate and in accordance with the type certificate. The make and type / model of the component shall be specified in the offer.
* The WTGs shall be complete with all parts and components necessary for normal operation during the lifetime of the WTG.
* All materials, components and equipment shall be new, factory made and designed to ensure- easy maintenance.
* Source of Components shall be furnished by the contractor.
* The equipment erected inside the tubular tower base shall be protected suitably taking into consideration the environment impact like corrosion.

##### **Main Design Criteria**

* The WTG must be suitable for continuous and satisfactory operation at the site for the prevailing wind and climatic conditions and designed to have a minimum of 20 years’ operating life. If the life of any of the components is less than 20 years, such components shall be listed, stating the expected life.
* The blades should be designed based on a standard specification (IEC 61400-5:2020 and DNV-ST-0376), which may be, indicated by number, date of issue, authority who issued.
* The WTGs shall have a minimum of two independent and fail-safe braking systems of which at least one must be of the aerodynamic type.
* The WTG operation and safety shall be governed by control and protection system. The protection system shall be activated whenever the WTG is not kept within normal operating limits due to Control System failure, effects of internal/external failure, or on account of any dangerous event.
* The Local Control System (LCS) of the WTGs shall be based on microprocessor having facility for fibre optic cable/RF based communication with central Monitoring & Control Station (CMCS) with a facility for remote control and a centralized remote monitoring system for control and monitoring and database system including supply of a good configuration personal computer for monitoring along with Ethernet option for remote access facility. Also, details of data logger for this purpose are to be furnished. Complete details of the offered System shall be furnished along with the offer.
* Cut-in speed shall be around 3.0 m/s to 4.0 m/s.
* Cut out wind speed of around 20 to 25 m/s.
* The offer shall give values for the following design parameters:
  + - * 1. The withstand capability for maximum 10 min. average wind speed at hub height.
        2. The withstand capability, for maximum 2 sec gust wind speed at hub height.
        3. The maximum operation wind speed, given as 10 min. average wind speed.
        4. The maximum electrical power output.
        5. The maximum rotor revolution speed.
        6. The certified Power curve.
* Details of auxiliary power supply as required for various segment of Electrical and Automations system shall be furnished. Similarly, provision of cooling system for Electrical panels etc. shall be separately brought out in the offer.

##### **Environmental Protection**

* All materials, components and equipment shall function and work properly during the lifetime without deterioration due to the climatic and coastal marine condition at the site.
* All exposed steel parts of WTG system must be protected against corrosion by using hot dipped galvanizing process. Minimum thickness of galvanization shall be 120 micron.
* All types of materials, coatings, and treatments are being considered for use in environments with salty air, particularly near the ocean.
* The methods to be used to protect against corrosion of all components of the WTGs shall be described and submitted along with the offer.

##### **Rotor**

The rotor shall be so manufactured as to be least affected by the tropical weather at site for its life, profile surface smoothness etc. The rotor should have its own aerodynamic brake so that extra torque due to strong wind, gust, storm, etc. is only marginally transmitted to the high-speed shaft of the gearbox if any. The blades shall be sturdy enough to maintain its shape and alignment when kept in stalled or stopped condition at any angle to the vertical and for a long period of time. Safety system of the rotor assembly shall be of fail-safe design. The blades of the rotor shall have in built lightning protection. This will be in addition to lightning protection provided for rest of Nacelle equipment.

##### **Transmission**

The gearbox, if provided, shall be of proven and special design suitable for WTG application with helical type design from an experienced and reputed manufacturer for long and trouble free operation. Standard components shall be used to give high reliability. The gearbox, if used, shall be provided with a temperature sensor mounted in the sump for measuring the oil temperature amongst other parameters. Information about the safety factor and lifetime of all gear wheels, bearing and shall be given in the offer. The transfer of vibrations from the gearbox to the nacelle shall be minimized. The contractor shall provide the relevant details.

##### **Braking System**

* As stated earlier, two independent braking systems shall be necessary out of which one should be aerodynamic type through tip brake or pitch control.
* The aerodynamic brake may be hydraulic or mechanical or electrical type but shall be so designed that braking force shall be applied evenly through all the blades to avoid vibration and undue stresses on rotor. The operation of the braking system shall be foolproof and shall have minimum adverse effect due to ingress of dust and water/ moisture into the moving parts. In any case these brakes shall have the facility of auto/ remote controlled resetting when activated. In case the hydraulic power pack is located in the hub, the unit shall be certified for operation at any position with respect to horizontal level and shall be unaffected by the centrifugal force experienced during over speeding of rotor. Safety precautions against loss of power in this braking system shall be incorporated.
* Fail-safe, heavy-duty electro-hydraulic or hydraulic brake shall be provided for mechanical braking of the rotor. This may be provided on high speed or low speed shaft but not on the non-driving end of the generator to avoid fatigue-failure of the generator shaft. The brake shall be adequately rated to stop the rotor at full speed during sudden power failure. Brake shoe line shall withstand temperature-rise at the time of braking and have adequate surface area for dissipation of thermal energy. The shoes shall be capable of withstanding a large number of operations before requiring replacement.
* An additional brake, manually operated from the nacelle, shall be provided, for holding the rotor in any position with main brake(s) dismantled for inspection and servicing.
* The contractor along with explanatory notes on their working principle shall indicate expected life of the braking system and the pads. The note shall also explain the safety feature for a situation when the WTGs are kept switched off for a long period for maintenance etc and disconnected from the grid.

##### **Yaw System**

The WTG shall be provided with an active yaw system responding to the signals from wind direction sensor. The yaw system shall possess a feature for automatic untwisting of cables connected to the Nacelle. The yaw system shall be protected against corrosion, dirt and also fatigue due to gust, storm, freak wind-shift etc.

##### **Tower**

* The WTGs shall have identical towers, either RCC or lattice or tubular type fabricated from structural grade steel sections or plates and shall be galvanized or painted as specified. The tower shall be designed for the dynamic loading imposed by the normal operation of the WTGs as well as to withstand survival wind speed without any damage. The permissible tolerances in fabrication of towers shall be as per the relevant IEC standards. Complete details of the RCC towers shall be furnished.
* The towers shall be provided with facilities like convenient climbing devices etc. for safe access to the nacelle and to the aerodynamic brakes. Safety ropes, belts and necessary foundation bolts should also be supplied.
* If tubular towers are offered and the local control panels and associated electrical equipment are installed inside the tower, lockable door shall be provided at the base of the tower. In case of lattice type tower, a separate electrical room with adequate protection against weather and unauthorized entry shall be provided. This room shall be in the scope of supply of the offer.

##### **The details of WTGs shall be furnished in the format provided at Annexure:7, Technical particulars of quoted model of WTGs**

* + 1. Electrical systems of WTGs
       1. General
       2. Electrical power and control systems of the WTGs must be designed for unattended, automatic service.
       3. The design must ensure
          - Desirable reliability.
          - Easy maintenance and services.
          - Maximum power production.
       4. All installations must be designed, fabricated and tested in accordance with latest publications from the International Organizations of Standards:

IEC: International Electro-technical Commission

* + - 1. The contractor may submit the details if they comply for any standard other than IEC.
      2. System Voltage
      3. The WTG system shall be designed to operate continuously and satisfactorily under following parameters:

i. 480 V, +/-5%, 3 phase, 4 wire

* 1. Frequency 60 Hz +/- 2Hz
  2. Current asymmetry: ±5%
     + 1. Tolerances exceeding above limits, will not be allowed.
       2. If the WTG are to be stopped or tripped beyond limiting values mentioned above, adequate time delay shall be incorporated for cooling of the electrical equipment in accordance with the system design.
       3. Contractor shall furnish the provisions for protection of the system or equipment when boundary conditions are violated.
       4. Generators
       5. The generators may be three phase asynchronous generators compatible for 60 Hz grid connection, designed for tropical environment and in accordance with international standards applicable for design and manufacturing of generators which are also approved type by certifying agencies in their approved valid type certificates.
       6. The generators shall meet the following technical specifications as a minimum:

1. Rated voltage : 480V, 3 phase according to the design of the Contractor
2. Rated frequency : 60 Hz
3. Rated output : To match WTG
4. Degree of protection (IEC) : IP55
5. Power factor : Power factor for all generation levels *shall not be less than 0.95*
6. Efficiency **:** Min. 90%
7. Insulation class: F/H as per approved in the type test.
8. Vibration category: As per relevant IEC
   * + 1. The generators shall be provided with temperature sensors installed in the stator windings being part of the generator protection system.
       2. If the systems design so demands, separate cooling fan with cooling fins and ducting shall be provided for the generator. This fan should preferably be automatically controlled through temperature sensing device.
       3. Generator windings etc. must be provided with special corrosion protection to cope with condensation problems caused by the high relative humidity / temperature gradient at the site.
       4. Generator shall be protected against short circuit, earth fault, over current and over/ under voltage. Contractor shall mention requirement of any other protection and shall also mention type and make of protection relays considered.
       5. Though an IP55 protection is specified, generators must be provided with drain hole.
       6. Generator construction, electrical and mechanical, must withstand cut-in at anti phase & cut out phase.
       7. The rated output and voltage shall match the varying availability of Wind Energy on one hand and all the possible grid connection on the other hand. In case variable speed WTGs are offered, complete details of power electronics used for this purpose shall be furnished along with the offer.
       8. Range of wind speed in which it shall be possible to synchronize the generator with the grid shall be furnished.
       9. Capacitor Banks/reactive power compensating equipment:

Since type of reactive power compensating provision is dependent on the design of WTG, the offer shall clearly establish its requirement so as to limit the power factor (more than or equal to 0.95) & reactive power *(not more than 5% of the active power exported on monthly basis).* Other requirement are mentioned below -

1. Reactive power compensating equipment should be able to adjust to the reactive power requirement of generator(s) so as to maintain a minimum power factor of 0.95 at *all operating conditions.*
2. *If switched type capacitors are used, they shall comply with the following:*
3. The capacitors must be connected when WTGs are running after the start procedure is terminated. Safety equipment must be provided for switching off the capacitors, when disconnected from the grid, to prevent to rise in voltage and production. The capacitor banks must be installed with a tightness class of minimum IP 21.
4. The rated voltage of the capacitors must be equal to the WTGs nominal voltage.
5. The capacitors shall in general conform to its IEC equivalent.
6. Capacitor shall be provided separately to compensate the reactive power drawl by the step-up Transformers installed for grid tie-up and this capacitor should be in parallel with the grid always, except whenever power is switched off.
7. The total reactive energy drawn (kVARh) from the grid to be metered.
   * + 1. Start Up

The current drawn by the WTG at the time of grid tie, up shall be limited to the full load current of the generator by providing suitable thyristor controls or other means. Provision for inhibiting start from the central monitoring system must be provided. The maximum inrush / starting current shall not exceed the full load current of the generator.

* + - 1. Power Panel

1. Each WTG shall have a power panel and it must include all power distribution for the WTGs, the protection systems, soft start, capacitor control, yaw motor and other auxiliary drive, control etc.
2. General data for the Power Panel:
   1. Control Voltage As per requirement
   2. Frequency 60 Hz+/- 2 Hz
   3. Prospective Short-Circuit level: 50 kA (RMS) symmetrical
   4. Degree of protection IP 54
   5. Incoming cable PVC insulated & armoured
   6. Space heaters required with thermostat.
3. The power panel and its bought out components shall be designed and manufactured in accordance with IEC standards.
4. The 480 volt, 3 phase supply between power panel and transformer shall be protected against short circuit by circuit breaker/ MCCB on distribution board. Lightning arrestors must be installed at the control panel end for protecting against voltage transients on the grid. The power panel frame shall be connected to earth at two points.
5. The switchboard must include two 4-wire, 10 amperes outlets to feed the lights and sockets in the nacelle and in the shelter of the WTGs. Socket outlets and light must be kept powered even when the WTGs is stopped and all remaining electrical installations isolated from the grid.
6. The generator overload protection system must be combined with temperature measurement of the generator windings to ensure maximum production time of the WTGs even at low grid voltage.
7. A phase relay must cutout the generator, if any of the phases is missing. Relays and computer systems must be fully functional at voltages drops up to -13% of 480 volts.
8. Voltage variations beyond +/-13% or ambient temperature above 45 degree C must not harm/damage the systems.
9. A mushroom type emergency push button must be located on the switchboard front.
10. A switch for preventing remote control operation must be located in the front of the switchboard.
    * + 1. Local Control System (LCS)
11. The offer shall include a microprocessor based, Local Control System panel, one each for every WTG offered in the Tender. Every panel shall have the control, alarm and measurement systems required for the satisfactory operation of the WTG.
12. The Control panel should be fed from a reliable source with a minimum required *power backup* system. The control system settings should be stored in a memory. Failure of *power backup system* must not erase the settings in the memory.
13. All the relays and other necessary protective systems as are required for the WTG must be provided, those relays or protection systems, which are not provided but are required as per the IEC 61850 or by the statutory agencies like GPL shall be provided by the Contractor at no extra cost to GEA. The protection systems to be provided shall include but not limited to:
    1. Generator thermal overload protection;
    2. Phase over current protection
    3. Generator winding temperature;
    4. Over and under voltage relay
    5. Single phase prevention
    6. Emergency push button
    7. Energy meters and hour counters
    8. Wind speed with timings
    9. Earth fault protection
    10. Differential protection;

The above are only an indicative list of electrical protection. Other mechanical protections and alarms are not indicated. The Contractors should specify each of the protection, alarm and measurement systems offered.

1. Three phase energy Meters shall be in accordance with the Metering Code of the National Grid Code.
2. The power panel must be provided with cooling and exhaust fan, thermostat controlled and adequate ventilation.
3. The local control system (LCS) together with the power system must fully protect the mechanical and electrical installations of the WTGs against break downs and at the same time, ensure a maximum overall energy production under given wind conditions.
4. The local control system shall be designed for automatic, unattended operation.
5. Electronics components within local control system shall be fully protected by low voltage surge diverter (such as varistor) against spikes generated in power network.
6. The frame housing local control system shall have adequate protection against corrosion.
7. The frame, if metallic, shall be grounded at two points.
8. The system should be able to display the following parameters:

##### Normal operation:

* 1. Status of WTG
  2. Wind speed (m/s) and wind direction instantaneous and 10-minute average
  3. Voltage (V), all three phases, R. M. S. values.
  4. Frequency (Hz)
  5. Current (A), all three phases in R. M. S. values
  6. Power output (kW) instantaneous & 10-minute average.
  7. Reactive power (kVARh) import.
  8. Power factor,
  9. Rotor revolution speed (rpm).
  10. Small generator revolution speed (rpm) (if any).
  11. Main generator revolution speed (rpm).
  12. Brakes activated.
  13. Accumulated energy production by small generator (if any) (kWh).
  14. Accumulated energy production by main generator (kWh).
  15. Operation time of small generator (if any) (h)
  16. Operation time of main generator (h).
  17. Yaw angle
  18. Generator 1 temperature
  19. Generator 2 temperature
  20. Gear box temperature
  21. Gear oil temperature
  22. Main bearing 1 temperature
  23. Main bearing 2 temperature
  24. Mechanical brake (blocks) temperature
  25. Yaw motor, temperature
  26. Hydraulic oil pressure in pitch control system (if pitch controlled)
  27. Hydraulic oil pressure in yaw system
  28. Nacelle temperature and switch board temperature

Any other parameters which are not mentioned but which are to be displayed for effective operation of WTGs.

##### Shut down, display and provision for visual alarm indication under the following conditions:

* 1. Low oil level or pressure in gearbox.
  2. Yaw failure
  3. Cable twist failure
  4. Control system failure
  5. Vibrations of the nacelle.
  6. Worn brake- pads
  7. Abnormal temperature in generator, gearbox, yaw motor, brake calipers.
  8. Grid failure i.e. frequency error, excess current asymmetry, voltage failure.
  9. Over speed of rotor.
  10. Activation of emergency stop.
  11. Aerodynamic brake operation.
  12. High temperature in switch board

##### Stop display and restart when conditions are acceptable again.

* 1. Low wind speed.
  2. Excessive wind speed.
  3. Untwisting of cables.
  4. Activation of stop push-button (Restart when start push-button is activated).
  5. Abnormal grid condition

##### Provide parameters and operational conditions to the Central Monitoring and Control System *(CMCS/SCADA)* in the Central Control Room.

##### LCS shall release the WTG after a shutdown caused by grid failure and the WTG shall start automatically, provided it was released by CMCS. The WTG shall be restarted manually only under all other shutdowns. If the CMCS is out of order, WTG shall be restarted manually only after shut down. LCS must be capable of reporting any shut down to the CMCS, giving enough information to identify the cause of failure. All set points of microprocessor or set points must be adjustable. The LCS must not depend on CMCS. If there is a fault in the CMCS, the LCS must continue to control the WTGs and keep it operable condition.

##### Indicative list of digital and analog l/O's for PLC/DCS system being offered is to be furnished.

* + - 1. Auxiliary power requirement for contactor/relays/control electronics etc. shall be met through a UPS. Its capacity and backup shall be mentioned.

Requirement of important control element are mentioned below:

1. **DC Power Supply** Shall be SMPS based suitable for wide input supply (85 - 264 V AC& 90- 350 V DC) preferred 125 V DC with power boost facility got reliable starting of loads and proactive alarm signals and selective fuse breaking capability, UL approved, safety in acc. With NEC standards.
2. **Signal barriers/Isolators** certified as per EMC guideline 89/36AEEC & UL 508 with 3-way galvanic Isolation and spring cage terminals.
3. **Interposing / auxiliary relays** shall be modular, pluggable mountable on DIN Rail with LED indication, UL approved.
4. **Transducer/signal converter /multipliers** shall preferably be configurable, 3-way galvanically isolated, mountable on DIN Rail and certified as per EMC guideline 89/E.EC, UL approved.
5. **Fibre optic converter** shall be industrial grade, modular on DIN rail and shall have support redundancy with diagnostic functions like bar chart display & remote output. These shall be certified as per EMC guidelines 89/336/EEC & the interference /immunity shall be as per EN 55 011/EN 61 000 -6 -2.
6. **Wireless Signal Transmission Device** (for Analog, Digital & Data Signals), if used, shall be based on Frequency Hopping Spread Spectrum (FHSS) technology, operating the licensed free Band (Frequency shall be 2400-2480 MHz) with Diagnostic Indications like RF link status with relay outputs. Approval for the use of frequencies must be sought from the relevant authorities prior to purchase of equipment.
7. **Terminal Blocks** shall comply with IEC-947-7-1. All metal parts shall be captive & made of Copper Alloys. Housing material shall fire retardant type and suitable for vibration level up to 5G.
8. **Perimeter Fence Lighting:** The Contractor shall design, supply, and install a solar lighting system for the fenced area of the WTG. The proposed system shall consist of 60W self-contained, solar-powered security lamps, with batteries mounted on 15-foot poles spaced 50 feet apart, installed along the entire perimeter fence of the WTGs.
   * 1. Surge protection devices shall be provided at following points with minimum requirements mentioned below:
9. **At the Input side of Main Distribution Cabinet (690 VAC/ 480/ 240V AC)**

The device used in this application shall be based single spark gap, stage-I/Class B type with rated voltage 440 VAC (for 690 VAC)/ 320 VAC (for 415 VAC) or above. The surge current handling capacity of device shall be 50 kA of 10/350µs waveform (between L-N) with a protection level of 2.5 kV (690 VAC)/ 0.9 kV (415 VAC). It shall confirm to the latest IEC- 61643 guidelines.

1. At the Input side of AC Drive Cabinet (690 VAC/ 480 / 240V AC), UPS, PLC Cabinets, Control Panels etc

The device used in this application shall be of stage II, Class C type. The surge current handling capacity of device shall be 20 kA of 8/20 µs waveform with rated voltage of 600 VA C (for 690 VA C) / 320 VA C (for 480 VA C) or above. The device shaft be pluggable, testable and shall have diagnostic functions like overload Indication and potential free outputs. It shall confirm to the latest IEC 61643 guidelines.

##### **At the Input Power Supply line of 24/48/60 V AC/DC**

The device used in this application shall be of stage III/Class D type. The device shall be pluggable, testable and shall have diagnostic functions like overload Indication and potential free outputs. It shall confirm to the latest IEC 61643 guidelines.

##### **At Bus Systems (like Profibus, Modbus etc) / Serial Ports (RS.232./485):**

The device (for the required 2-wire or 4-wire Interface) shall have the surge handling capacity of 10 kA (Core-Core) & 20 kA (between Core-Ground). The device shall be pluggable & on- site testable. It shall confirm to the latest IEC 61643-21 guidelines.

##### **Ethernet Networks**

The devices for Ethernet networks shall be able to protect all 8 signal paths with discharge surge current handling capacity of 350,4/ 2.5kA (between Core-Core / Core-Ground) of 8/20 µs waveform. The device shall confirm the test standards in acc with IEC 61643-21.

* + 1. Soil data

The contractor should conduct geotechnical investigation on their-own and design structures accordingly. It should be noted that contractors should furnish the foundation and tower stability report to GEA along with the geotechnical investigation report.

* + 1. Tower foundation

The civil works related to construction of WTG tower foundations shall be executed by the contractor. The foundations shall be designed to take adequate care of the possible soil condition and adverse seismic effects on the basis of soil conditions of the site. For this purpose, the contractor is required to carry out the soil investigation prior to the foundation work. The contractor shall upon his selection, submit a report consisting of the following so as to establish the adequacy of tower and foundation design:

1. Geotechnical investigation report carried out.
2. Foundation design calculations (to be submitted to GEA)

The soil conditions, wind survival speed, load on tower and foundation, together with such other parameters required for a safe design of tower and its foundation shall be considered by the contractor.

* + 1. Earthing and grounding

Design of the grounding system and supply and installation of all materials required for grounding the WTGs for proper performance of electrical and electronic components, for safety of personnel against lightning shall be provided by the contractor. The installation must comply with the requirements of relevant provisions of IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems. The soil resistively test shall be done by the Contractor for the design of suitable earth pits and report submitted to GEA and GPL.

* + 1. Equipment grounding against ground fault

1. All electrical frames shall be effectively connected to earth at two points at two distinct locations at both ends. Materials required for earth electrodes as well as earth conductors shall be supplied by contractor. Combined earth resistance at each WTG shall be less than 2 (two)) ohms.
2. The cover slab on the earth pit shall be adequately labeled as per the relevant provisions of IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems.
3. All mechanical parts made of metal shall be bonded and connected to earth. The earthing system must follow the IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems, including any statutory requirements of GPL.
4. The earth electrodes of WTG systems shall be provided as per IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems and the contractor should append a drawing showing the earthing arrangement for WTGs and transformers.
   * 1. Lightning and over voltage protection
5. The Contractor shall provide suitable earthing grid to protect the nacelle and tower against lightning strokes as per IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems. Effective earth resistance of electrodes shall be 2 Ohms or less as required by relevant standards.
6. Care shall be taken to protect electric and electronic equipment within the control panel against any lightning / switching surges which are expected in electrical network. For this purpose, the contractor shall provide their own lightning arresters / varisters within the control panel.
7. Lightning Arrester shall be of appropriate voltage and impulse current rating to protect all power equipment within WTG system. They shall be readily accessible and easily replaceable. Lightning Arresters shall be provided with some indication, which would enable the operator to ascertain if it has been ruptured.
8. Varistor or any other low voltage surge diverter shall be used to protect the electronic control cards against spikes generated in power systems.
9. Lightning protection provided for rotor blades, shall be highlighted indicating the scheme and design details.
   * 1. Cabling

##### **Cable type**

Two categories of cables shall be provided, one for stationary equipment and the other for movable equipment and components. Irrespective of utilization voltage and current rating, all cables shall have copper conductor and shall be minimum of 1100 volts grade. The cables shall be adequately insulated for the voltage required and shall be suitably colour coded for the required service. The contractor shall furnish the size and rating of cables along with the offer.

1. **Cable end termination**

The cable ends shall be terminated with adequate size metallic double compression cable glands/PVC *glands* and the glands shall be earthed at two locations. Suitable lock type crimping lugs shall be used for cable end terminations. Where cables are raising from ground, suitable PVC pipe guarding shall be provided for cable raising with sealing of the guarding PVC pipe including a suitable clamp.

* + 1. Electrical installation

1. **Codes and standards**

All electrical installations shall be carried out in *accordance* with generally accepted installation expected for the Wind Power Plant and specifically shall comply with the relevant provisions of:

* + - 1. IEEE/ANSI standards.
      2. GPL requirements;
      3. GEA requirements; and
      4. Recommendations of any insurance included in the liability scope of the contract.

1. The entire installation must be of proper design, convenient for maintenance and shall be of excellent workmanship.
   * 1. Grid Interconnection and System’s Integration
        1. The Point of Interconnection (POI) of the Wind Farm shall be at the 13.8 kV level of the Solar PV Farm. The Bidder shall investigate the relevant details regarding the current grid interconnection of the Solar PV farm at 13.8 kV and develop an interconnection scheme compliant with the National Grid Code, Employers Requirements and NESC Rules that satisfy the requirements of this Project.
        2. The connection of the WTGs shall follow the equipment architecture and philosophy described in this section of the Tender. Overhead outdoor buses will not be acceptable. The only outdoor equipment shall be the voltage step-up transformer(s) and WTGs.
        3. The interconnection between the 13.8 kV switchgear and the POI shall be via overhead, three-phase 13.8 kV interconnection line, engineered and constructed in accordance with the Employer Requirements and Technical Specifications.
        4. The Bidder shall specify the grid interconnection arrangement in accordance with the relevant sections of the National Grid Code and other applicable Industry Standards that can deliver an effective and reliable power evacuation scheme of the Project. Bidder shall develop and produce an Electrical Single Line Diagram (SLD) of the Wind Farm that satisfies the Employer’s Requirements and relevant Technical Specifications.
        5. The Bidder shall submit five (5) drawings that captures the details of all relevant system component that are included in the response to this Tender. See the followings:
           1. SLD No.1: includes all technical details, commencing from each WTG up to the Point of Interconnection. The technical information required in this SLD shall inform of all relevant nameplate ratings of WTGs, circuit breakers, underground and overhead cables, bus bars, transformers, disconnect switches, surge protectors, grounding resistors and any other critical and relevant system component.
           2. SLD No. 2: includes all technical details, commencing from each WTG up to the Point of Interconnection. The technical information required in this SLD shall inform of all relevant nameplate ratings of CTs and PTs for both metering and protection and the relay protection functions. Regarding all CTs and PTs, the bidder shall also include the Accuracy Classification, referenced standard and Short-circuit rating. Further, the bidders shall inform of the relays manufacturer(s), accuracy range(s) and logic.
           3. Lighting scheme protection for the complete Wind Farm, including switchyard, Control Building and other areas within the Wind Farm that may be considered a safety hazard for personnel.
           4. System and Equipment grounding for the Wind Farm, which shall include all equipment of this Project.
           5. Any required modifications to the Solar Farm’s SLD or Lighting and/or system and equipment grounding to allow for seamless and safe interconnection.
        6. The interconnection configuration with the POI can either be per WTG or collectively as complete Wind Farm.
        7. The 13.8 kV section of the Wind Farm shall comprise a 15 kV class indoor switchgear that has the required number of cubicles that comply with the Employer Requirements and Technical Specifications to allow for the interconnection of the WTGs voltage step-up transformers and the POI.
        8. The Low Voltage section of the Wind Farm shall comprise a 1,000 V class indoor switchgear that has the required number of cubicles that comply with the Employer Requirements and Technical Specifications to allow for the interconnection of the WTGs, WTGs voltage step-up transformers and auxiliary loads.
        9. The bus bar load current rating of the 1,000 V class indoor switchgear shall be determined by the bidder to ensure compliance with the nominal rating of the Wind Farm at the selected low voltage level. The short-circuit rating of this switchgear shall be rated to withstand the maximum fault current of the hybrid energy system.
        10. The bus bar load current rating of the 15 kV class indoor switchgear shall be determined by the bidder to ensure compliance with the nominal rating of the Wind Farm at 13.8kV. The short-circuit rating of this switchgear shall be rated to withstand the maximum fault current of the hybrid energy system.
        11. In the case of both 15 kV and 1 kV class cubicles, it is the responsibility of the bidder to ensure that each cubicle has structural integrity and other critical features and amenities to accommodate the suitable cable sizes for this Project.
        12. The bidder is responsible for selecting the appropriate nameplate ratings of all CTs and PTs, as well as relevant instruments and Intelligent Electronic Devices (IED), all compliant with the relevant IEEE requirements.
        13. Regarding Instrumentation, for both 15 kV and 1 kV class cubicles, Bidder to ensure that the instruments are certified calibrated to measure, record and display Line and Phase Voltages, Line Currents, Three- and Single-Phase Power Factor, Frequency, Active and Reactive Power, Energy Exported and Imported, etc.
        14. The WTGs and voltage step-up transformers shall be connected using underground copper cables using a 1,000 V class indoor switchgear.
        15. The copper cable for the Low Voltage section of the Wind Farm shall be of suitable rating to match the nominal output of each to WTG as well as maintain voltage drop within 2.5% and can withstand the maximum short-circuit current of the hybrid energy system within the fault clearing time. The bidder shall clearly demonstrate the methodology of cable selection for the offered WTG in the bid submission.
        16. The copper cable for the 13.8kV section of the Wind Farm shall be of suitable rating to match the nominal output of each to WTG as well as maintain voltage drop within 2.5% and can withstand the maximum short-circuit current of the hybrid energy system within the fault clearing time. The bidder shall clearly demonstrate the methodology of cable selection for the offered WTG in the bid submission.
        17. All cables shall be installed in covered concrete trench. Bidder to take this installation configuration into consideration when sizing all power cables.
        18. The nominal rating of each WTG voltage step-up transformer shall be ONAN rated and selected to satisfy the nominal rating of the WTG in accordance with the SLD provided. The transformer(s) shall satisfy the technical specifications provided in this tender. Further, the ONAN rating of the transformer(s) shall be of such value that at nominal output of the WTG(s) the thermal loading shall equal to or less than 75% of nominal capacity. Additionally, the transformer(s) shall comply with IEEE C57.91-2011 to ensure project longevity.
        19. Per SLD, Each the transformer(s) shall be protected on both sides by phase and ground fault protection supervision functions, voltage, frequency, as well as voltage surge protective devices and any other required protection functions deemed necessary by Industry Standards.
        20. The transformers shall be mounted on suitable separate concrete plinths, equipped with required retention bunds.
        21. The transformer area in each WTG shall be provided with perimeter fencing to always ensure safety for personnel and security of the assets. The minimum height of the perimeter fence shall be 10 ft from the finished surface of the concrete plinths. The internal distance between the fence and the widest or most protruding part of the transformers shall be a minimum of 10 ft to ensure personnel safety.
        22. All the equipment and installation shall be complete in all respects and any device component or material not included in the specification but essential for proper operation of equipment and safety of personnel and equipment shall be included within the scope of work whether specifically mentioned or not.
        23. The Bidder shall be responsible for identifying the appropriate location on the Wind Farm for the Control Building and Switchyard, as well their internal layout specifications.
        24. The Bidder shall be responsible for providing access paths/roads on the Wind Farm location between all facilities.
     2. Standards
        1. The equipment, accessories, cables, conductors and other materials covered by this Contract shall be designed, manufactured and tested in accordance with the latest relevant standards published by the IEEE/ANSI.
        2. All electrical installation shall conform to the latest relevant codes of practices published by IEEE/ANSI, NEC and NESC.
        3. All Electrical equipment and installations shall conform to the latest versions of IEEE Std 80-2000, IEEE Std 142-2007, and IEEE Recommended Practice for System Grounding of Industrial and Commercial Power as it regards to safety, system and equipment grounding and other essential provisions specified therein for installation and operation of electrical plants.
        4. All equipment and installation shall comply with the statutory requirement of the National Grid Code, relevant IEEE, NESC, NEC and NEC standards.
     3. Transformers
        1. The bidder shall furnish the technical particulars of the voltage step up transformers in accordance the Employer’s Technical specifications.
        2. Factory Acceptance Test shall be completed at the manufacturer’s facility of the transformer. All test results shall be forwarded to the Employer for review before commencement of shipment. Refer Annexure 8 of list of attachments.
        3. The transformers shall be of vector group Dy11, oil immersed, naturally cooled (ONAN), outdoor type of connection to a 13.8 kV system with tapings of +/- 2.5% to cover voltage rating of +/-5%. See Technical Specifications of transformers for more details.
     4. Other equipment like energy meter, metering set, vacuum circuit breakers etc.

The offer shall include for every WTG a three phase energy meter with provision of backup, which will prevent the meter from rotating backwards when power is drawn from the grid. The energy meter shall be of 5/1 amps rating with suitable CT. The HT energy meter shall also have TOD facilities so as to facilitate minimum three slot- peak period, normal period & off period - metering of electrical energy. Contractor shall furnish the technical details including make and type of all the electrical equipment required for grid tie up other than the transformers. The details of Vacuum Circuit Breakers shall be furnished in the format provided at Annexure:9 of List of Attachments.

* + 1. Machine performance guarantee

The contractor shall offer guarantee as indicated in Annexure – B. (Guaranteed Parameters for Machine Performance).

* + - 1. Failure to attain Power Curve Generation Guarantee (PCGG)

This shall be as indicated in Annexure – B(Guaranteed Parameters for Machine Performance).

* + 1. Penalty for shortfall in guaranteed machine availability:

This shall be as indicated in Annexure – B. (Guaranteed Parameters for Machine Performance) during O&M period including the defects liability period.

* + 1. Compensation for excess reactive power drawn

This shall be as indicated in Annexure –B. (Guaranteed Parameters for Machine Performance) during O&M period including the defects liability period.

* + 1. Penalty for excess internal losses

This shall be as indicated in Annexure – B. (Guaranteed Parameters for Machine Performance) *during O&M period including the defects liability period.*

* + 1. Testing of WTGs

As already stated, all the components are to be type tested as per the relevant standard. The WTGs also have to be *certified/ recognized* by manufacturing country norms. Major components of the WTG offered in the Tender shall be of the same make. The materials for major components shall be confirming to international standards

* + 1. Inspection and testing

1. Contractor should have Quality Assurance Plan (QAP) for manufacturing, erection and commissioning processes. This QAP should be available for reference during inspection of GEA officials at manufacturing unit and site. However along with the offer the Contractor should attach the list of routine tests to be conducted at each stage on major components with relevant International standards.
2. It may be noted that all items shall be carefully inspected and tested by TPIA during manufacture and prior to dispatch in accordance with the standard practice of the manufacturer and the applicable standards. Test certificates in triplicates shall be supplied before the dispatch of equipment. Cost of TPIA charges should be borne by the successful Contractor. However the following major items as per manufacturers’ quality assurance test plan available at works shall be offered to GEA representative/ TPIA:-
3. Routine testing of 1 no. of WTG Transformer and verifying the routine test certificates of balance quantities.
4. Routine testing of 1 no. of Generator for and verifying the routine test certificates of balance quantities.
5. Blade test certificate to be verified.
6. The Contractor shall extend necessary co-operation to third party inspection agencies, and GEA inspection teams for effectively carrying out the inspection / testing. However such inspection does not absolve the Contractor, the responsibility to provide performance guarantee/ warranty. The Contractor shall strictly comply with the quality requirements suggested by the inspecting authorities from time to time.
   * + 1. Factory Tests

Factory Acceptance Tests (FAT) include testing, adjusting and calibration of all components and systems, details of which should be given in QAP. The FAT protocol shall be submitted for review by the Employer. The FAT programme shall include but not be limited to:

1. Balancing of blades/shafts
2. Mechanical brake system
3. Hydraulic system
4. Power system, according to IEC and factory standard test.
5. Switch board, according to IEC and factory standard tests.
6. Safety systems
7. Soft start systems
8. Local control system
9. Control functions
10. Alarm functions
11. Display functions
12. Calibration of sensors and total systems
13. Central monitoring and control system
14. Control functions
15. Automatic data collections
16. Automatic data analysis
17. Calibration of sensors and total system
18. Protective Relay Devices.
19. SCADA and other relevant equipment and systems.
20. Voltage step-up transformers.
21. Power Cables
22. 13.8kV and Low Voltage Switchgears
    * + 1. Site Acceptance Tests

The Bidder shall be responsible to complete all required Site Acceptance Tests (SATs). SAT protocols shall be submitted to the Employer for review and approval before commencement of Tests. The SAT shall include, but not be limited to:

1. Test of functions of the WTGs.
2. All Switchgear, Instruments, IEDs and Systems.

All tests and results shall be reported and presented to GEA or their representatives. If defects or failures are discovered during the tests the Contractor shall undertake to repair or replace or carry out improvements as deemed necessary.

* + - 1. Commissioning tests

During the commissioning of the total Wind Power Plant, the following inspections and tests will be carried out:

1. Identification of technical *data* of all the WTGs and the monitoring systems
2. Visual inspection of all the WTGs and monitoring systems
3. Function tests of all the WTGs, protection and monitoring systems as per OEM manual.
4. Operation test of the total Wind Power Plant (WTGs and monitoring systems) as per QAP.

The operation tests are accepted as fulfilled only after trouble free operation continuously for 10 days and after each of the WTGs has produced energy based on the guaranteed power curve and percentage frequency distribution of wind speed. For the purpose of issue of completion certificate, the date of completion would be the date of grid interconnection and issuance of a commissioning certificate by GEA. As regards the warranty, two months stabilization period will be considered.

* + 1. Documentation

The drawings, instruction manuals, which are to be furnished by the Contractor, shall be clearly indicated with broad time schedule with respect to finalization of Contract and are as follows:

* + - 1. Operation and Maintenance Manuals

The contractor is required to prepare a detailed Operation and Maintenance manual for the wind plant. When preparing the O&M manual, the contractor shall be guided by the requirements set out in ‘Annex 5: Leguan Wind Power Plant Operation and Maintenance Requirements’.

Four sets of **drawings / manuals necessary for O&M, repairs / replacements shall be supplied.**

The manuals must be in English and shall contain following information.

1. All information necessary for operation and maintenance
2. All functions of technical installations should be clearly explained.
3. Full description of when, how and where maintenance and operation check has to be performed
4. Maintenance overview, operation check list, instructions etc, which describe the kind and extent of work on all items, shall be included.
5. A separate manual containing the site details including the equipment etc.
   * + 1. List of drawings for Grid Interface

It is the responsibility of the Contractor to prepare the drawings required for the Tender submission and will be the responsibility of the Contractor for preparing and submitting the drawings required for NOC, Grid tie up and necessary approval etc. However, the drawings pertaining to the services to be provided by GEA, if any, shall be indicated by the Contractor.

* + - 1. Details of Contractor's Drawings, Reports and Documents

The list of drawings, number of copies, mode of submission, approval will be mutually agreed between the Contractor and GEA. However, the following drawings together with other drawings mentioned in other part of the Offer Document shall be submitted by the Contractor as required:

1. Site Map and Electrical related layouts and diagrams
2. General Arrangement drawings of major components like Gearbox, Tower, WTG / Nacelle, Transformer & Generator shall be supplied.
3. Operation, control and safety logic in form of ladder diagram or similar representation and explanatory notes on control and safety philosophy.
4. Layout, piping, control logic, safety etc, for hydraulic system including description as required.
5. Schematic control and wiring diagram for electrical power and control system, lightening protection system etc.
6. General arrangement drawing of electrical panel showing layout of internals.
7. Specification and requirement of spares and consumables indicating log and cat. nos, make etc.
8. Design drawings for all civil works including foundation, electrical room, cable trench, cable duct etc.
   * 1. Communication with LCS
9. The LCS performs the data acquisition on the wind WTGs and grid. All data measured on WTGs must be accessible for CMCS/SCADA. Besides the WTGs, the LCS is to measure voltage on three phases and frequency of the grid.
10. Data transmission between LCS and CMCS/SCADA must be serial interface, 20m A current loop or standard RS-232C. Contractor may specify in the Tender the method of interfacing between LCS and CMCS/SCADA.
    * 1. Sensors & controls
         1. The sensors must be robust and reliable and calibrated by certified testing agencies and the measured data must fulfill the requirements of accuracy.
         2. The Contractor has to monitor, operate and control the entire Wind Power Plant through Central Monitoring Control Station (CMCS)/SCADA. The Contractor shall make arrangements for the CMCS for this project and the cost of which should be included in the project cost. The following operation of the individual WTGs shall be possible to carry out from CMCS:
         3. Stop the WTGs
         4. Start the WTGs
         5. Reset the counters
         6. Change the alarm limit.
         7. After certain faults as per LCS settings, the WTGs are restarted automatically. To avoid excess voltage drops, the *CMCS/SCADA* must inhibit start of more than one WTG at a time. The time between start of WTGs must be adjustable in the range 0 to 60 sec.
         8. All alarms must be reported immediately to *CMCS/SCADA.* All alarms must be printed out in clear text, describing the kind of alarms, where the alarm occurred and the time of initiation of the alarm. Resetting of alarms is to be printed in the same form. Print out of alarms must not interrupt print out of reports. It must be possible to specify maximum and minimum limits for all alarms.
         9. **Exhibition of data**

On demand, the screen shall show the following pictures and data:

1. Map of the wind power plant with WTGs suitably numbered for identification and meteorological masts.
2. Actual power generated and operation status (on/off) of each WTG.
3. Wind speed, direction (figure and arrow), air temperature, and air pressure from wind masts may not be linked to CMCS but shall be downloaded separately
4. Table showing the following data for WTG
   * + - 1. Wind WTGs number
         2. Active power
         3. Reactive power
         4. Energy production, main generator
         5. Energy production small generator (if any)
         6. Power factor
         7. Operation time (main and small generator)
         8. Total operation time
         9. Local wind speed
         10. Local wind direction
         11. Ready for yawing, green yes/white no
         12. Ready for normal operation, green yes/white no
         13. Freewheeling, green on/white off
         14. Operation, green on/white off
         15. Yawing left green yes/white no
         16. Yawing right, green yes/white no
         17. Automatic cable untwisting green on/white off
         18. Automatic reset expected red yes/white no
         19. Generator 1green on/white off
         20. Generator 2 if any green on/white off
         21. Manual operation green on/white off
         22. Remote stop executed green on./white off
         23. Manual reset required red yes/white no
         24. List of alarms/failures
         25. Rotor speed
5. It must be possible to reset alarm in the screen picture (after the cause of failure is rectified).
6. Alarms, which are reset at the WTGs, shall automatically be reset on this screen picture.
7. Active alarms with text, date and time may be in red color. After reset text, date and time must change to white.
8. The last 10 alarms must always be presented on screen.
9. Manual stop also to be reported on the alarm list.
10. It must be possible to switch different WTGs from the screen pictures "Wind WTGs", "Mechanical", "Electrical" and "Operate WTGs" without returning to main menu in Power plant overview.
11. The screen on demand shall show the following parameters (Mechanical) in graphical form.
    * + - 1. Wind WTGs number
          2. Gear oil temperature
          3. Oil level (ok/alarm)
          4. Main bearing temperature
          5. Mechanical brake temperature
          6. Brakes activated (on/off)
          7. Yaw motor temperature
          8. Nacelle temperature
          9. Yaw system, hydraulic pressure
          10. Yaw angle
          11. Rotor speed
12. Manual stop also to be reported on the alarm list.
13. The screen on demand shall show the following parameters (Electrical) in graphical form.
    * + - 1. Wind WTGs number
          2. Generator temperature
          3. Generator revolution
          4. Active power
          5. Reactive power
          6. Power factor
          7. Voltage (3 Phase)
          8. Current (3 phase)
          9. Frequency
          10. Switch board temperature
14. The screen on demand shall show the following wind power plant parameters
    * + - 1. Wind WTGs number
          2. Operation (on/off)
          3. Number of active alarms (not reset)
          4. Active power
          5. Reactive power
          6. Power factor
          7. Wind speed and
          8. Wind direction
          9. Total active power
          10. Total reactive power
          11. Average active power
          12. Average reactive power
          13. Wind speed and direction from Mast 1
          14. Wind speed and direction from Mast 2.
          15. Air Temperature
15. It shall be possible to carry out the following tasks from the screen, but with password. In order to avoid errors, activation of any of these tasks shall cause a text to appear on the screen, which has to be answered before the order can be executed. For example the text could as "Stop the wind WTGs type Yes/No"
    * + - 1. To start/stop the WTGs
          2. Reset counters and change alarm limits.
          3. To start/stop all the WTGs, reset counters and change *alarm* limits

In case Central Monitoring and Control System (CMCS) has not been considered as supply item and not supplied as a part of the WTG and service of Existing CMCS from the vicinity is utilized, then the charges should only be included in the O&M contract price. In such cases the displays would be as per the existing available facility and acceptable.

* + - 1. **Generation of Reports**

CMCS shall be capable of generating various reports on operation, maintenance, breakdowns, generation, etc of the wind power plant required for analysis and decision-making at various levels of management. The Tender shall include the required software and hardware for carrying out all the functions under CMCS/SCADA.

* + - 1. **Write up on WTGs**

The Contractor shall furnish brief details/technical literature of the offered models of WTGs along with the Tender.

* + 1. Design improvement
    2. The Purchaser or the Supplier may propose changes in the specifications of the equipment or quality over and above the guaranteed performance and if the parties agree upon any changes, the specifications shall be modified accordingly.
    3. If any such agreed change is such that it affects the price or completion schedule, the parties shall agree in completion schedule or both, before the supplier proceeds with the change. Following each agreement, the provision them of shall be incorporated in an amendment to the contract.
    4. Protection against high temperature and dust storms
    5. WTGs need to be suitably protected. All-materials, components and equipment shall function and work properly during the lifetime without deterioration due to the aggressive climate conditions and dust loading. Details shall be furnished on protection methods / precautions adopted for the satisfactory performance of WTGs for such conditions, without fail.
    6. If the technology for generation at WTG is at different voltages, it may be accepted. However, the evacuation of the electrical energy will be at 480 V or a voltage suitable to GEA.
    7. In case Contractors' technology does not require or specify some technical requirement and it does not materially affect the generation of electricity, price, safety, security of human being, electricity rules of the land and life of the project, it can be dispensed with.
    8. Wind mast should be of 8 quadrant type or better and approved makes are Second wind / NRG. Its height should not be less than the hub height of the offered WTG.
    9. Reference list

Contractor shall submit along with the bid the reference list strictly as per the Annexures given in the List of Attachments (Annexure –A).

* + 1. Preferred make list

Contractor shall ensure that various components offered by them shall be specified complying to IEC standards with the reputed companies for these items. Contractor may offer any other make, which shall be ASTM/ DIN approved.

**List of items with their company make**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No** | | **Item** | | **Company Make** |
|  | | **13.8 KV outdoor electrical equipment** | | |
| 8 | | 13.8 kV Vaccum Circuit Breaker | |  |
| 9 | | 13.8 kV Class Power Transformers | |  |
| 10 | | 13.8 kV Disconnecting switches / Isolators | |  |
| 11 | | 13.8 kV Lightning Arrestors | |  |
| 12 | | 13.8 kV CTs | |  |
| 13 | | 13.8 kV PTs | |  |
| 14 | | 13.8 kV Insulators | |  |
| 15 | | HT Switchgear Kiosk | |  |
| **Medium voltage switchgear and control gear** | | | | |
| 16 | 480 **V** Air Circuit Breaker | |  | |
| 17 | Moulded Case Circuit Breaker | |  | |
| 18 | MPCB | |  | |
|  | **Cables and cabling accessories** | | | |
| 19 | 13.8kV, XLPE Cable | |  | |
| 20 | 2 kV PVC/XLPE (Power) | |  | |
| 21 | 2 kV PVC/XLPE. (Control) | |  | |
| 22 | Energy Meter | |  | |
| 23 | Communicable Energy Meters | |  | |
| 24 | INSULATORS | |  | |
| 25 | AB Switch | |  | |
| 26 | DO Fuse | |  | |
| 27 | Lightning Arrestor | |  | |
| 28 | MCCB | |  | |
| 29 | Cables (LT) | |  | |
| 30 | AAC | |  | |
| 31 | LIGHT FITTING | |  | |
| 32 | PVC WIRE | |  | |

##### Contractor can change the makes during the execution, with prior approval of GEA only. Contractor shall submit the source of components as per the format enclosed as Annexure:10 of List of Attachments (Annexure –A).

##### **Erection/ installation /Commissioning of all the above items**

##### All the above items, including any other items, which are required for successful commissioning and operation of wind form, shall be erected as per relevant standards and to ensure satisfactory functioning of wind form.

##### Items/Information not specified but required / Essential

##### Contractor shall quote for the supply of any additional equipment and materials, which are not specifically mentioned in this Contract but are required to complete the system, offered by him in every respect, and for safe and efficient operation and guaranteed performance. It shall be the responsibility of Contractor to furnish such materials and equipment and provide the services specified accordingly.

##### Contractor shall provide all tools, tackles, equipment/ machinery, materials/ consumables and labour required for execution of work and the quoted rates shall be inclusive of all such charges.

##### **Commissioning**

1. For the purpose of issue of completion certificate, the date of completion would be the date of grid interconnection and issuance of a commissioning certificate by GEA. As regards the warranty, two months stabilization period will be considered.
2. During commissioning test run, the Contractor shall guarantee continuous operation of WTGs without interruption, generating rated capacity of power for the prevalent wind conditions. The WTG shall also operate within the limits specified for power supply.
3. Commissioning shall be done strictly as per OEM’s instructions manual, International Electro technical Commission. History cards shall be provided for each WTG.

##### **Guarantee/ warranty**

1. The manufacturer's guarantee for all supplied items shall be made available to GEA and shall be valid at least for the entire defect liability period. If manufacturer's guarantees are not so available to GEA, the Contractor shall guarantee the items supplied for the entire defect liability period. However, in case the manufacturer's guarantee period is in excess of the defect liability period, such guarantees for such excess period shall be passed on by the Contractor to GEA.
2. Any material and/or equipment and/or accessories which shall prove defective or which shall fail to meet the desired design guarantee or performance guarantee during the defects liability period, the Contractor shall replace at his own cost that material and/or equipment and/or accessories with another of make approved by GEA. Manufacturer's/ Contractor’s guarantee for such replaced equipment shall also be made available to GEA and should be kept valid at least for two years from the date of last replacement.
3. The Contractor shall guarantee the installation for a period of 14 (Fourteen) months including stabilization period of 2 months from the date of issue of commissioning certificate. Any damage or defect, that may arise after or remain undiscovered at the time of issue of commissioning certificate, same shall be rectified or replaced by the Contractor at his own expenses as deemed necessary by the engineer-in-charge. This guarantee shall be applicable for the quality of works executed as well as for the equipment/fittings supplied by the Contractor.
4. GEA reserves their right to call for required guarantee directly by the manufacturer / Contractor's / Associate/ Sub-Contractor through suitable agreement.

##### **Documents to be submitted along with offer**

* + 1. Submission of following documents, drawings, data, design and engineering information to GEA / consultant for review along with this Contract:

1. Brief technical specification.
2. General arrangement drawings of major critical equipment.
3. Micro-siting plan & Wind power plant layout. Soft copy of map file with UTM coordinates, time series wind data for a period of one year. Location and turbine coordinates with respective map and power and thrust curves of proposed machines holding valid type certificate.
4. Schematic diagram for evacuation system.
5. G. A. drawings for O.H. lines, 69kV switchyard & Earthing details.
6. Drawings and Details as specified.
7. Any other Technical details called for in the Contract.
   * 1. Statuary Approvals
8. The model of WTGs offered should be as per IEC latest list. Documentary proof to this effect must be submitted along with the offer.
9. The Contractor shall submit a copy of the IECs latest list indicating inclusion of the model of WTGs offered and IEC’s valid certificate including power curve.
10. The Power curve and Thrust curve should be submitted along with the offer in tabular form.
    * 1. Power Evacuation Facility

The offered site should have adequate power evacuation facilities to Leguan Grid. This should be certified by GEA Authorities. Documentary evidence to this effect should be submitted along with the offer.

* + 1. Data for Foundation

1. Contractor shall furnish the drawing for the foundation for the WTGs along with their offer duly approved and certified by reputed structural engineer.
2. The Contractor should also furnish the plan and construction details of the control rooms required for housing the power, local control panel & CMCS System duly approved and certified by reputed structural engineer.
   * 1. Energy Computation

The Contractor shall submit detailed Mico-siting report for arriving estimated annual generation for the wind power plant at each site and furnish all the input informations/ data including maps, drawings, wind data considered for calculation in hard copy and soft copy both.

* + 1. Technical Data

The Contractor shall furnish technical data and documents complete in all respect as per Annexures from 6 to 10 of List of Attachments (Annexure –A) of the Contract.

* + 1. Scheme for Grid Interfacing:

Contractor shall submit complete scheme for Grid interfacing and interconnection for Wind Power plant at each site including schematic diagrams and the basis of design and brief specification of equipment, materials and installations along with the offer.

* + 1. Sources of Components

The Contractor shall furnish the make and source of the various components of the WTG as per Annexure:10 of List of Attachments (Annexure –A).

##### **Documents to be submitted by the successful contractor**

The successful Contractor shall be required to provide four copies of the following information, drawings and documents, within three weeks of the placement of order:

1. Compete technical specifications of the WTG including rotor, nacelle and tower
2. Operation/ Maintenance/ Trouble-shooting manual including detailed drawing for local control system (LCS) as well as Central Monitoring & Control Station/ SCADA (CMCS)
3. The Specification of lightning and other voltage protection.
4. The Specification of anti-corrosion treatment.
5. Necessary drawings like layout of machinery and equipment including electrical equipment’s.
6. Detailed planning network diagram within a month from the date of signing of the contract.
7. Detailed of provision for target power factor of turbine shall be furnished. Also details of reactive power from grid for all modes of operation i.e. start up, continuous operation and line fault conditions shall be furnished.

##### **Documentation required to be handed over after commisioning:**

The following documents will form the completion certificate documents:

1. The technical documents according to which the work was carried out.
2. Four sets of as built drawings (hard copy) showing therein the modification and corrections made during the course of execution and 2 sets of soft copy in CD.
3. Certificates of tests performed for various works.
4. Statutory clearances / permissions.
5. TPIA Test reports.
6. The copy of certified initial meter reading of main meter and back up meter signed by power utility authority, etc.
7. Commissioning certificates from GEA
8. All other relevant documents.

##### **Scope of work during guarantee/ warranty period and during operation and maintanance:**

* + 1. General

GEA wishes to entrust the total comprehensive O&M activities of the 0.5 MW (± 50 kW) wind power plant including power evacuation system in the Leguan Island to the Contractor initially for a period of 1 (one) year including comprehensive O&M during warranty period of 12 months excluding stabilization period of two months after commissioning. The period of comprehensive operation and maintenance contract may be extended further on mutually agreed terms and conditions with GPL.

* + 1. Scope

1. To maintain at the facility accurate and up-to-date operating logs, records and monthly reports regarding the Operation & Maintenance of Wind Power Plant.
2. To perform or contract for and oversee the performance of periodic overhauls or maintenance required for the facility in accordance with the recommendations of the original equipment manufacturer.
3. To maintain and keep all control room, roads, tool room, stores room, equipment, etc. in workable conditions.
4. To discharge obligations relating to retirement/ Superannuating benefits to employees or any other benefit accruing to them in the nature of compensation, profit in lieu / in addition to salary, etc. for the period of service with the Contractor.
5. 14 months free O&M during warranty period including stabilization period of two months after commissioning including spares and consumables etc complete.
6. The Contractor shall be responsible for all the required activities for the successful running, optimum energy generation etc.
7. Deputation of engineering and supporting personnel.
8. Successful running of WTGs for optimum energy generation.
9. Monitoring, controlling, troubleshooting of wind power plant including CMCS and wind mast & maintaining of relevant data.
10. Supply of all spares and consumables necessary for Operation and Maintenance.
11. Conducting periodical checking, testing overhauling and preventive action.
12. General up keeping of all equipment, building, roads, wind power plant land area.
13. Submission of periodical reports to GEA on the energy generation & operating conditions of the wind power plant.
14. Continuous monitoring the performance of the Wind Turbine Generators and regular maintenance of the whole system including WTGs, transformers, overhead line, control panels etc. as necessary for extracting and maintaining the maximum energy output from the wind power plant.
15. Necessary spares including capacitors, consumables etc shall be arranged by the Contractor at his own cost.
    * 1. Operation and performance monitoring
16. Operation part consists of deputing necessary manpower to operate the wind power plant at the maximum capacity as agreed in the contract.
17. Daily work of the operators in the wind power plant involves logging the voltage, current, power factor, power and energy output of the wind power plant, battery voltage, specific gravity, temperature, logging down individual WTG's output data once a day. The operator shall also note down failures, interruption in supply including grid failure and tripping of different relays, reason for such tripping, duration of such interruption etc.
18. The operator shall record monthly energy output of each WTG and reports shall be prepared on performance of wind power plant indicating turbine wise production. Down time, capacity factor, machine availability etc. and these figures shall be computed for the total wind power plant.
    * 1. Maintenance
19. The Contractor shall draw the preventive maintenance schedules and attend to the breakdowns keeping in view that the machine availability is more than 95%.
20. The Contractor shall carry out the periodical/plant maintenance as given in the manufacturer’s service manual including that of wind mast and CMCS.
21. Regular periodic checks of the WTGs shall be carried out as a part of routine preventive maintenance during low wind period. In order to meet the maintenance requirements stock of consumables are to be maintained as well as various spare as recommended by the manufacturer as per the requirement.
22. Maintenance of other major equipment involved in wind power plant are step-down transformers, overhead line equipment and outdoor 69 kV VCB panel and metering panel. Particular care shall be taken for outdoor equipment to prevent corrosion. Cleaning of the insulators and applying Vaseline on insulators shall also be carried out at every 3 to 4 months interval. Resistance of the earthing system as well as individual earth pit is to be measured and recorded every month. If the earth resistance is high, suitable action is to be taken to bring down the same as per IEC Rules

The Operation and Maintenance of the External Grid / overhead lines which is owned by hinterland electrification/ GPL is excluded from scope of O & M contract. However, as O&M agency, the co- ordination with the concerned authorities will have to be maintained on priority for getting necessary repairs / replacements done.

1. According to the recommendations stock of special tools and tackles shall be maintained for WTGs and other major electrical equipments.
2. A maintenance record is to be maintained by the operator to record the regular maintenance work carried out as well as any breakdown maintenance along with the date of maintenance, reasons for the breakdowns, steps to be taken to prevent recurrence.
3. The Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the WTG’s, shall be carried out preferably during the non-windy season.
4. The Contractor shall deploy enough manpower at wind power plant site to carryout work instructions and preventive maintenance schedules as specified.
5. The Contractor will attend to any breakdown jobs immediately for repair/ replacement /adjustments and complete at the earliest working round the clock.
6. The Contractor shall immediately report the accidents, if any, to the nominated GEA official & to all the concerned authorities as per prevailing law of the state.
7. The Contractor shall comply with the provision of all relevant Acts of Governments.
8. The Contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.
9. The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his or his Co-Contractor.
10. Indemnify GEA for any losses arising out of above acts and shall undertake responsibility to comply all statutory rules & regulations governed under the said acts.
11. If negligence/ mal operation of the Contractor's operator results in failure of equipment such equipment should be repaired / replaced by Contractor at free of cost.
    * 1. Quality spares & consumables

In order to ensure longevity and safety of the core equipment and optimum performance of the system the Contractor should use only genuine spares of high quality standards.

* + 1. Tools and tackles

The Contractor shall arrange for all the necessary tools and tackles including crane for carrying out all the operation & maintenance work covered under this contract.

* + 1. Security services

The Contractor has to arrange proper security system either dedicated for this project or common facility available for the wind farm in that area including deputation of security personnel at his own cost for the check vigil for the wind power plant. The security staff may be organized to work on suitable shift system. Any occurrence of unlawful activities shall be informed to GEA immediately.

##### **Manpower & Utilities**

Deployment of manpower, required consumables, testing equipment during erection till commissioning and during O&M, arrangement of power & water as required for this contract shall be arranged by the Contractor**.** The broad terms are specified in the draft O&M contract . However, the precise terms and conditions would be discussed on mutually agreeable terms before completion of warranty period