# Section IV: Schedule of Requirements

# Annex – A

# Requirement Definition/Terms of Reference

# Gozareh Industrial Zone – Hybrid Clean Power Plant

**June 2016**

**LIST OF ACRONYMS:**

| | |
|---|---|
| MV: | Middle Voltage |
| EPC: | Engineering Procurement and Construction |
| REN: | Renewable Energy |
| UNOPS: | United Nations Office for Project Services |
| DABS: | Da Afghanistan Brishna Sherket |
| SCADA: | Supervisory Control And Data Acquisition |

## 1. BACKGROUND AND JUSTIFICATION

The United Nations Office for Project Services has received funds from the government of Japan for enhancing energy supply and energy security in Afghanistan through Renewable Energy (REN) Solutions. The project will be implemented by UNOPS on behalf of the government of Japan and the Client which is the Ministry of Energy and Water of the Islamic republic of Afghanistan.

As part of the project objectives of Energy Security and improved Access to electric in Herat, The project will install total of 2 Megawatts (MW) of renewable energy generation through a hybrid photovoltaic and wind generator electricity production plant in Herat. The plant will provide power to approximately 1500 Households (10,000 person) and 100 small businesses in Herat to support the private industries, growth in Herat to promote job creation as part of the much needed public infrastructure. The electricity will be connected to the existing transmission lines which will also benefit future regional connectivity project such as railways.

The UNOPS now requires the services of a Contractor or an Original equipment manufacturer (OEM) for provision of subject requirement.

## 2. OBJECTIVE

United Nations Office for Project Services (UNOPS) is now looking for suitably qualified and experienced company (hereinafter referred to as "Contractor") which can effectively delivery the supply, delivery, installation, testing and commissioning of the hybrid solar/ wind power plant as well as its MV transmission line (hereinafter referred to as "Services") in Herat province in Afghanistan. The construction should be made on an EPC turn-key basis.

## 3. MINIMUM QUALIFICATIONS REQUIREMENTS FOR THE CONTRACTOR

In line with its objective, UNOPS intends to sign a Contract for Professional Services (hereinafter referred as "Contract") for the provision of services under consideration with an Offeror that shall possess the following qualifications and whose proposal shall best meet the requirements, as set out in this Terms of Reference:

**3.1.** Sound general organizational capability and demonstrated ability to provide the services under consideration.

The following statistical data will have to be provided:

- Key clients and their contact details (to be contacted for reference checks);
- Company's organogram with details of qualifications of management staff;
- Number of technical and support personnel in the organogram of the Offeror;

**3.2.** Litigation and arbitration history of the Offeror does not bear any potential reputational or other risks for UNOPS or other United Nations organizations and specialized agencies.

The Contractor shall provide information with a sufficient level of detail with regards to any suits and arbitral proceedings in which the Contractor was involved for a time period of 3 years prior to the date of the release of this RFP.

**3.3.** Financial indicators prove Offeror's long term sustainability and possession of sufficiently sound financial position to ensure it can meet its financial commitments under the Contract.

The following documents will have to be provided:

- Audited financial statements for a time period of 3 years prior to the date of the release of this RFP; and/or
- Copy of the firm's bank balance to demonstrate amount of liquid assets and/or credit facilities net of other contractual commitments and exclusive of any advance payments which may be made under the contract.

**3.4.** Relevant specialized knowledge and capacity.

The following information will have to be provided:

- Information about the Offerors capacity to plan and execute the works with the specified timelines;
- Quality control and quality assurance mechanisms and SOPs;
- Approach and methodology for the successful execution of the works;

**3.5.** Experience in similar project(s).

The following statistical data will have to be provided:

- Number, value and duration of contracts for similar works over the last 3 years accomplished

**3.6.** Have suitably qualified key-experts for provision of the services.

The following information will have to be provided:

- Number of Solar or Wind specialists in the Offerors' organization;
- Number of Civil and Electric Engineers
- A short summary of their qualifications, background and experience;
- Areas of specialization;
- Successful projects accomplished;
- Any other relevant facts and information.

## 4. SUMMARY OF WORKS AND SERVICES

United Nations Office for Project Services (UNOPS) is looking for a competent Contractor for the design, supply, delivery, installation, testing and commissioning of the hybrid solar/ wind power plant as well as its MV transmission line. The plant has to reach 2.0 MW of installed power and shall be located at Gozareh Industrial Zone, close to the Herat international airport, on the West area of Afghanistan.

The installation shall have a rated nominal power of 2.0 MW, of which at least of 1.2 MW power made up with solar photovoltaic panels and at least 0.25 MW made up from wind turbines. The production will be injected into the DABS Gozareh substation through 20kVA transmission lines and switching also to be built by the Contractor.

The brief description of the requirement is as below;

- Design Procurement and Construction of a ground-based Solar Photovoltaic Plant form injection to the grid. The Solar ParkPark will have a minimum of 1.2 MWp power and include:
  - A fence and a gate
  - A CCTV surveillance system,
  - A 3 room building with washroom, which will house:
    - The monitoring and control room
    - The guards room
    - Spare parts
  - a step-up 20 kV transformer switching and protection
  - an underground MV transmission line.
  - The Park shall include a weather station (sharing with the wind Park)
  - Monitoring system reporting locally as well as remotely by GSM or Internet
  - Backup power system (4 hours at full load)
  - Fire-fighting equipment
- Design procurement and construction of a Wind Farm, of at least 250 kW of rated power, for injection to the grid. The farm should be provided on a turnkey basis and therefore include:
  - All necessary civil works for access, foundations, crane pads, trenches, and other, required to install and operate the proposed equipment.
  - Each turbine will be surrounded by a fence.
  - The farm shall include a weather station (sharing with the solar Park)
  - The farm will be equipped with a complete SCADA system reporting locally in the PV plant control room as well as remotely by wireless GSM
  - 20kV step-transformer and switching / protection equipment
  - MV transmission line to evacuate the energy, (underground if wind site A is chosen otherwise aerial)
- Provision of all MV components for connecting the plant to DABS sub-station, including bi-directional metering.
- The total installed capacity shall be of 2.0 MW

Finally, the Offerors are encouraged to include in their proposal an offer for 5 years Operation and Maintenance services for the hybrid plant.

## 5. LOCATION DETAILS

The solar plant will be built in the DABS Gozareh Substation compound.

Coordinates of the site:

- 34° 11’ 00” N
- 62° 13’ 01” E
- Elevation: 1020 m asl

For the wind Park there are 3 (there) possible terrains, Offerors can choose the one they prefer. These are:

**Site A**

- 34° 11’ 03” N
- 62° 13’ 10” E
- Elevation: 1018 m asl

**Site B**

- 34° 09’ 44” N
- 62° 12’ 17” E
- Elevation 1120 m aslr

**Site C (same site as solar)**

- 34° 11’ 00” N
- 62° 13’ 01” E
- Elevation: 1020 m asl

The Solar Park is to be built inside the substation compound, on its south-western quarter. The wind farm shall be built:

Site A either outside of the said compound, in a plot of land adjacent to it to the East,

Site B or on a hill 2.5 km further South, or

Site C in the same plot as the solar PV

The land for the solar plant does not present any particular difficulty, except maybe the projected shadows from nearby towers and trees.

In contrast the lands for the wind farm present some difficulties and some restrictions. These are:

**Site A** is traversed by the western boundary of the airport’s aircraft approach surface, which effectively divides the plot of land into two,

- the western area where construction height is limited to 35m,
- the eastern area where construction is restricted to horizontal surfaces like roads only

In addition some noise emission limitations there should be taken into account, as there are some offices in the neighborhood.

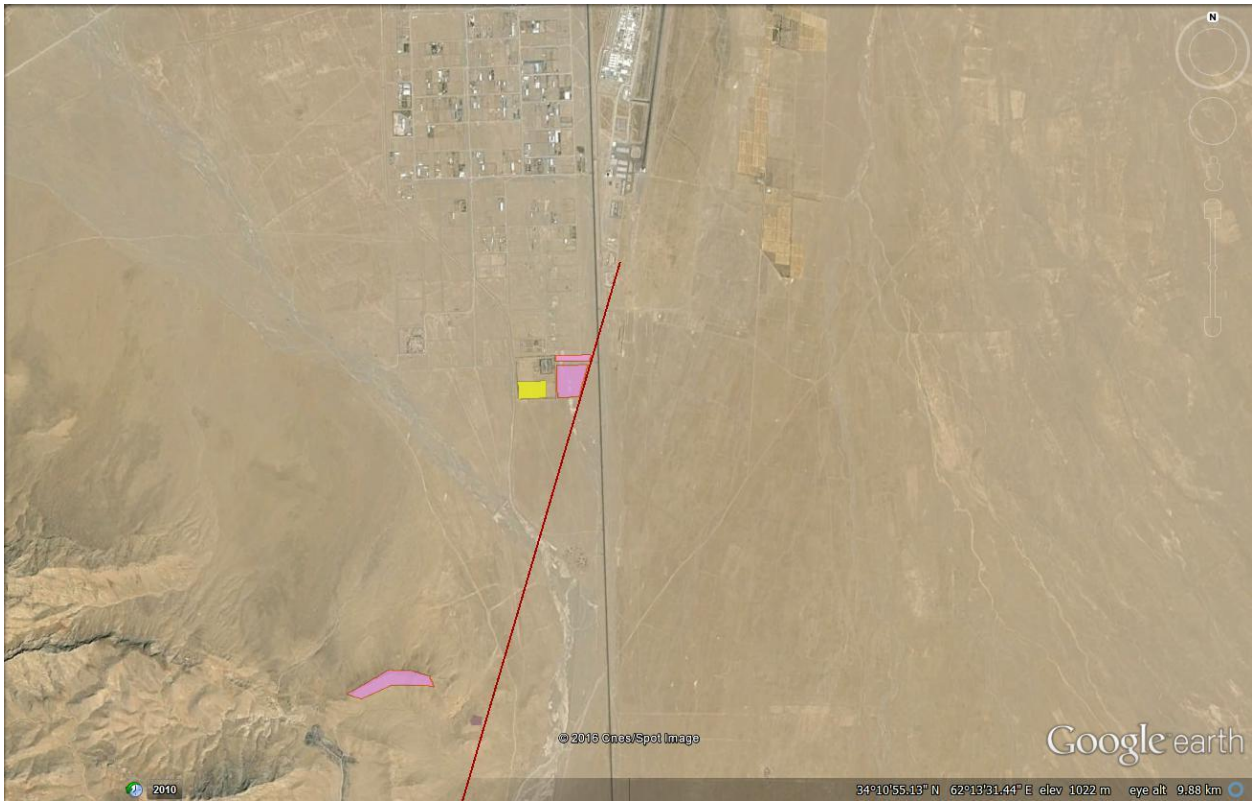
**Site B** presents no restrictions in height of construction, or in noise emissions, but has no road of access and the terrain is quite rocky.

**Site C** is somewhat small, and is limited in height to 40m total. It also has restrictions on noise.

## 6. OTHER INFORMATION

Together with this RFP document is provided:

- a Topographic map of the PV site, of wind site A and wind site C and of immediate surroundings,
- A normalized . climate file of the sector, comprising solar irradiation, air temperature and wind values, on hourly basis, which must be used by Offerors to carry out their simulations of production. Offerors proposing wind turbines on site A must use wind data of 30m anemometer, while Offerors proposing wind turbines on Site B should use data from 50m anemometer. The file is electronic (*.CSV format).
- A month-by-month rosewind assembled from the airport weather station data,
- Electronic pictures of the sites


© 2015 Cnes/Spot Image
Google earth
2010
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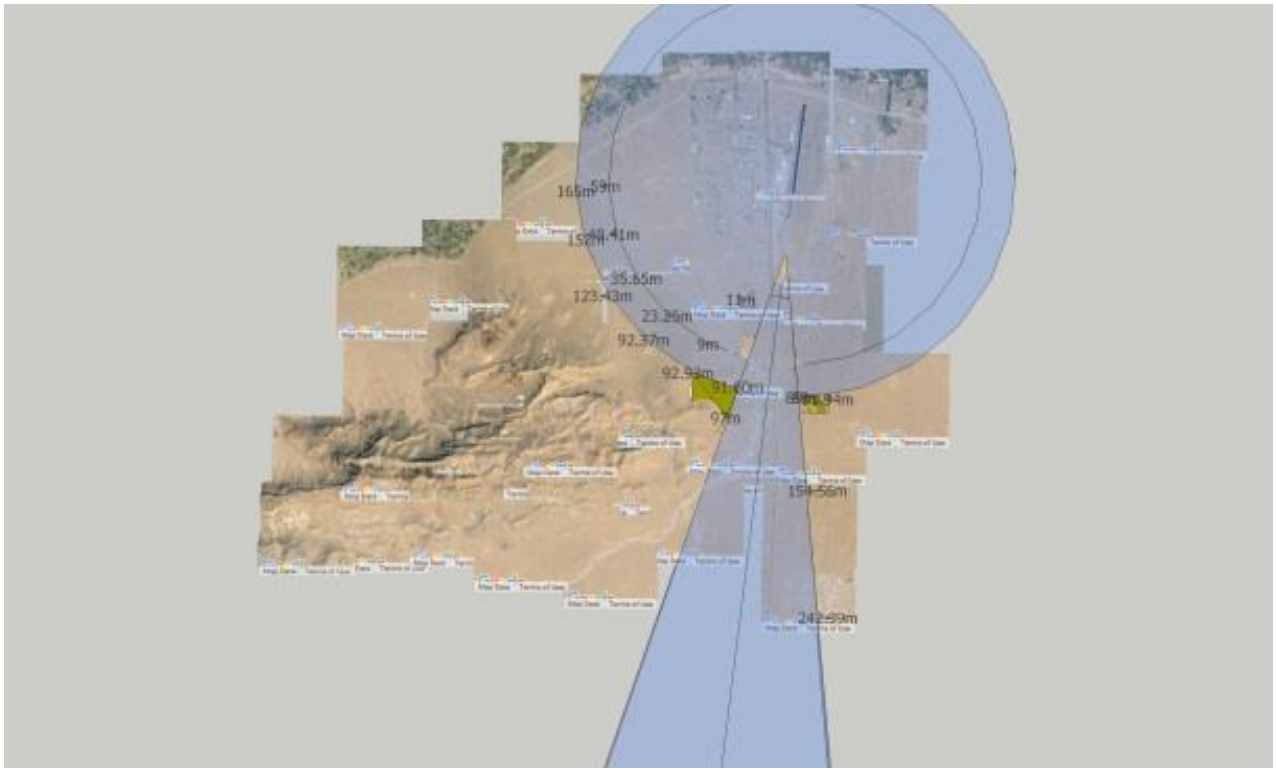

165m
59m
152m
41m
35.65m
123.43m
1km
23.26m
92.37m
9m
92.93m
91.60m
97m
159.56m
242.59m

# 7. GENERAL REQUIREMENTS

## 7.1. Guarantees

The Contractor shall be fully responsible for performing all works as necessary to achieve a complete and fully operational plant in accordance with the specifications. Any defect or deficiency in the power plant, whether attributable to the Contractor's errors or omissions or defects in equipment or workmanship supplied by vendors or subcontractors, will be remedied by the Contractor at his own expense. It is the intention of the Owner that the Contractor maintains his planned progress throughout the performance of the contract; therefore the Contractor is required to achieve all intermediate milestones during the performance of the contract. Failure to achieve the agreed schedule and milestone will render the Contractor liable to pay liquidated damages.

The Contractor will provide a 2 years full guarantee. This guarantee shall include Performance warranty which will be measured yearly, at the end of first and second year.

On top of the 2 years full guarantee Contractor shall provide larger product warranties given by manufacturers. For solar modules minimum ten (10) years product warranty required, for Inverters minimum five (5) years required, for support structure minimum five (5) years required.

If guarantees are not met, the Contractor will be responsible for investigating the reason for such failure and making proposals for correcting any defects in the solar power plant. After obtaining the Owner's approval, the Contractor will be responsible for implementing such modifications. Any changes required shall be at the Contractor's own expense unless the Contractor can demonstrate that the reason for the failure was outside Contractor's responsibility.

## 7.2. Insurance

The Contractor shall submit details of insurances it will have during the construction and operation of the plant, before signing of the Contract.

## 7.3. Local regulations compliance

Offerors shall also take into account all the relevant laws, rules, and regulations of Afghanistan. During construction Contractor shall comply with all local regulations and follow local standards. Where no local standards are defined Contractor shall follow international standards.

## 7.4. Health and Safety

Contractor will be responsible for the Health and Safety and waste management during construction of the plant and until de property was transferred to the Owner.

Contractor shall follow all applicable Afghan standards related to H&S, and complying with all applicable Afghan building codes, laws, and regulations.

## 7.5. Acceptance Process

The Contract with the Contractor will detail the Acceptance process, which will include a Provisional Acceptance after the plant is finished and connected to the grid, and a Final Acceptance and the end of the warranty period (2 years).

The Provisional and Final Acceptance will include, among others, the measurement of the performance of the plant.

## 7.6. Security during construction

Contractor shall be responsible for site security from the start of the construction to the Provisional Acceptance.

Contractor shall ensure materials are protected from theft and that no unauthorized persons access the site.

For this purpose a security company for 24 hours, seven days a week shall be subcontracted.

## 7.7. Defects Notification Period (DNP)

DNP Is the period for notifying defects in the works/services calculated from the date of substantial completion of the project. The DNP of the project shall be 1 (one) year. During this period UNOPS may at any time prior to the expiry of the DNP period, notify the Contractor of any defects or outstanding work. The Contractor must remedy at no cost to the UNOPS any defects due to the contractor's design, Materials, plant or workmanship not being in accordance with the contract. The timing for remedying defect shall be reasonably agreed by the both parties.

## 7.8. Limits of retention money:

UNOPS shall retain 10% of the contract amount as retention money for a period of 1 (one) year.

## 7.9. Release of retention money:

In principle, the retention money is released after the issuance of the final completion certificate. However, for this specific project, the retention money shall be released upon issuance of the substantial completion certificate against a bank grantee which should be unconditional /irrevocable and in a format acceptable to UNOPS.

### 7.10. Timelines

The successful Contractor is expected to fully complete the delivery, installation, construction, including testing and commissioning of the plant within 6 (six) months form the date of contract commencement date. Failure to do that will result in penalties.

### 7.11. Deliverables

| Milestone |
|---|
| 1. Delivery of the Solar equipment on site |
| 2. Delivery of the Wind equipment on site |
| 3. Completion of the solar Park |
| 4. Completion of the works |
| 5. End of defects notification period |

### 7.12. Proposed Contractor Team Composition

The Contractor's staff should have extensive experience in Renewable Energy generation.

Joint venture is acceptable.

Minimum requirements for the composition and qualification of the Contractor's project team are provided in the below table:

**Contractor's Team**

| Description of Staff | Level of Qualification (minimum) | Years of professional experience (minimum) |
|---|---|---|
| **Wind and solar Expert which should act as Project Manager/Team leader.** | BSc. in Civil Engineering or Electric Engineering | 5 years in managing similar projects |
| **Civil Engineer** | BSc. in Civil Engineering | 4 years in road design and 1 year in road construction projects or alike |
| **Electrical Engineers** | BSc. in electric or mechanical engineering | 3 years |

Good knowledge of spoken and written English by the Contractor's key staff is essential. The Contractor shall include CVs of all their key staff proposed for this project.

### 7.13. Cost and Payment of the Contractor's Services

The Contractor shall meet the full operational costs of its field teams including all travels, remuneration, insurance, emergency medical aid, accommodation, offices and facilities, communications and all that is necessary for the proper operation of the teams. Costs shall include administrative and technical support from the Contractor's Head Office. Payment to the Contractor shall be made on the basis:

| Milestone | Payment |
|---|---|
| Delivery of the Solar equipment on site | 25% |
| Delivery of the Wind equipment on site | 25% |
| Completion of the solar Park | 20% |
| Completion of the works | 20% |
| End of defects notification period | 10% |

### 7.14. Quality Assurance and Quality Control (QA/QC) requirements:

UNOPS will perform a quality assurance review of the Contractor's work to verify that proper criteria, regulations, laws, codes, principles and professional procedures have been used. UNOPS shall have full involvement during the practical implementation of the project.

# 8. TECHNICAL REQUIREMENTS

## 8.1. Site preparation works

The land allocated is composed of two Parkels, one for solar, one for wind.

### 8.1.1. Solar Park

Land for the Solar Park is located inside of the DABS substation compound. Access is done through the gate of the compound, which leads to a compacted earth tertiary road with sufficient room for normal sized trucks. This road however finishes about 150m before the plot, therefore some compacting and stabilization and graveling be required to reach the solar plant itself.

Land preparation for the Solar Park itself should comprise:

- Removing the vegetation and grading.
- Compacting and graveling of the peripheral solar field road
- Compacting and graveling of the roads accessing all the buildings
- Trenches to bury all AC and MT cables
- After assembly is finished, the land between the tables and as far as feasible under the tables should be planted with grass, compacted slightly, and handed over to the DABS gardener to water until the grass has grown sufficiently.

### 8.1.2. Wind Farm

For the wind farm Offerors can choose between two alternative sites:

#### 8.1.2.1. Site A

This land is located outside of and adjacent to the substation compound (between the compound and the road). In fact the land available for the erection of wind turbines is limited to the east not by the road, but by the airport's aircraft approach surface, which is drawn with a diagonal on the map, and under which construction is very restricted.

**Access:** to this terrain will require some more works since, on the one hand, the terrain is partly the former bed of a rainwater drain, and on the other the access needs to withstand the heavy equipment (large trucks 100T cranes) that will follow.

The number of access roads as well as its or their alignment will depend on Offeror's design of the wind farm.

- Access roads are to be a minimum 5m across and 400mm depth.
- Access road material to be 100mm down or equivalent material approved by C&F engineer.
- Access road to be capped with clause 804. The road should be free from objects that can damage or puncture vehicles.
- Any gradient in excess of 8 degrees or narrow road width/entrances must be discussed with crane supplier.
- The road overhead clearance must be a minimum of 5 metres from the surface of the road.
- Geotechnical test (CBR) test carried out on several sections of the proposed access road.
- Geotechnical engineer to confirm if geotextile membrane is required.
- Identified soft spots to be removed and built up in 200mm layers of 100mm down and vibrated with roller.
- Access road to be inspected by C&F engineer before commencement of turbine foundation
- Access road entrances from secondary roads to be adequate for 14m truck and 100T mobile crane.
- After the turbine has been erected the access road and crane platform are to be retained for future maintenance works.

#### 8.1.2.2. Site B

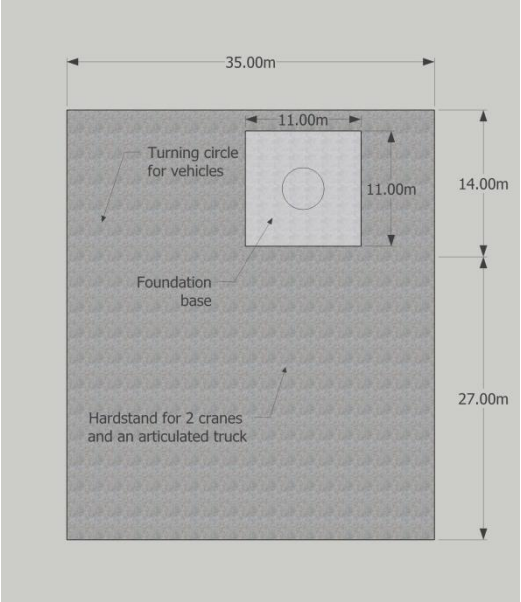
On this site Access has to be done from scratch. Offerors can evaluate the feasibility during the site visit.

#### 8.1.2.3. Site C:

Site C is in the same plot of land as the solar park. Therefore the same comments apply. However, the space is tight (due to the surrounding walls and the presence of HV high voltage transmission line), so caution will be required during construction and maintenance. Naturally the design must prevent shadows from the turbines fall on the solar panels. And please note that maximum total height permitted here is of 40m.

### 8.1.2.4. Crane Pad

The construction site for medium size turbines must be designed with a crane pad to ensure that the mobile cranes specified have adequate and safe lay down and working areas.




- The crane pad to be identified by C&F engineer onsite before any works commence. During this site investigation the orientation of the crane pad will be determined.
- Each crane pad to be constructed to the dimensions required by the turbine manufacturer. The dimensions shown below are indicative and tentatively appropriate for 100 kw turbines.
- Geo testing (CBR or plate bearing tests) to be completed at random locations on the crane pad and the geotechnical engineer to confirm if the ground conditions are suitable for the specified crane.
- The crane pad drainage must be constructed to control the flow of surface water on, alongside and around the Crane Pads so as to self-drain.
- The crane pad is to be excavated to a minimum depth of 500mm to ensure no settlement of cranes and trucks during the construction and erection of the wind turbine. Once excavated 100mm down or approved equivalent material is to be installed in 250mm layers and rolled.
- Construction recycled material should not be used as hard-core fill unless the material is crushed and has been signed off by a C&F engineer.
- All imported material should be compacted and vibrated using a vibrating roller
- The crane hardstand should be free from objects that can damage or puncture vehicles.

### 8.1.2.5. Buildings

Provision must be made for the safe and proper lay-down and storage of parts in a suitable secure location. Parts include and are not limited

to: lifting tools, service platforms, uninterruptible power supply, tower cables and work platforms.

## 8.2. Photovoltaic Generator

### 8.2.1. General Descriptions

We are looking at a standard ground-based PV solar installation connected to the local grid, with fixed support structures and string inverters. The system is intended for 25 years life time.

The PV installation shall have its own fence, separated from the substation. Along this fence there shall be a security CCTV system.

There shall be a building for control room and spare parts storage.

A Medium Voltage transformer station shall be also located here.

UPS backup system must be provided to power for lights, SCADA and CCTV for 4 hours in case of grid failure.

System design has to be optimized for maximum annual yield (no seasonal preference).

Maximum design of input (PV Installation kWp) per output (Inverter installation kWe) ratio shall not be over 110%. nor under 100%. In other words, inverter kW nominal power should be equal to or exceed by not more than 10% the PV nominal power.

The installed capacity shall be of *at least* 1.2 MWp.

- The overall system design for the solar power plant shall include:
- Building for control room and spare parts storage (minimum 7 x 3.5m, 3 rooms (control and monitoring, guards, spare parts)
- Building for MV transformer station (separate or attached to the control building)
- Grounding protection
- Meteorological equipment with pyranometer air temperature and wind speed at solar field level
- Fire protection system on the buildings and equipment to fight electric fires in the solar field and transformer room
- Single Line Diagram

### 8.2.2. Solar Panels

Proposed PV Module shall be Tier-1 world class quality with high efficiency and durability.

- PV Modules are required to be procured from the well-known and financially strong manufacturer in order to ensure relevant long term warranty.

- Solar panels have to have a mono-crystal or poly-crystal cells.
- The power tolerance of the solar panel has to be between 0/+5 W.
- The solar panels have to have resistance against up to 130 km/h of wind speed.
- The solar panels have to be tough enough to resist snow loads of 5400 Pascal and wind loads of 2400 Pascal (should be 5400 preferably).
- The glass which covers the panels has to have the property to not reflect the solar radiation.
- The minimum efficiency value of the solar panels has to be 15% under the standard test conditions.
- All the solar panels have to have the same brand, power capacity and structure.
- The solar panels have to have minimum 10 years of physical warranty. This warranty has to be provided by the Offeror in the tender file.
- The solar panels have to have at least 25 years linear power warranty. Power warranty has to ensure 90% of rated power for 10 years and 80% of rated power for 25 years. The maximum degradation per year cannot be more than 0,7%. The both warranty conditions have to be proved and covered by the Offeror. This clause has to be defined at tender file.
- The solar panels have to have three by-pass diodes in case of the power loss due to shading.
- The solar module junction box has to have at least the IP 65 protection class and has to be proved by certificates such as TUV, SGS and UL which are internationally accredited. This information has to be clearly indicated in the presented technical data sheet.
- The solar panel shall have been certified by an independent accredited laboratory to the IEC 61215 and IEC 61730 standards. These standard documents have to be presented together with the tender file.
- Also an independent testing institute such as TÜV or ISE, shall have certified that PV modules are free of PID (potential induced degradation). These certificates shall be submitted.
- The system operating temperature range has to be -40°C/+90°C.

Panels with best thermal behavior will be preferred.

Panels specially made for desert conditions will be amply preferred.

The application classification of the panels has to be Class A.

- The Offeror has to include the data sheet of the panel they propose in the tender file. This data sheet shall show at least:
- Voc (Open Circuit Voltage), Isc (Short Circuit Current), Impp (Optimum Operating Current), Vmpp (Optimum Operating Voltage), and Pmpp (Nominal Maximum Power),
- Thermal coefficients (Pmpp %/°K, Voc %/°K),

- Panel efficiency (%),
- Physical properties such as size, weight etc.,
- Test Certificates from ESTI or another research institutes such as TUV Rheinland, Fraunhofer ISE, which are internationally accredited,

On each module has to be written:

- The name of the manufacturer company,
- Module type
- Cell type (mono-crystal or poly-crystal)
- Serial number,
- Nominal power,
- Production date,

Finally, panels have to be delivered with a flash test report, to facilitate their sorting by power during assembly in order to reduce mismatch losses.

### 8.2.3. Mounting Structure

The support structure of the solar panels will be a ground based fixed structure. This can be made with Aluminum or galvanized steel. If galvanized steel, minimum thickness of zinc layer shall be 70 µm.

- Foundation type shall be pile driven posts (ramming poles). A ramming test need to be done by the Contractor [1]before starting the works.
- Pile-driven foundation posts must be made of steel, hot-dip galvanized. A zinc dust primer is to be used to coat the top 30 mm of the foundation post, inside and outside.
- The mounting structure, with the solar panels on top, has to be resistant against 130 km/h wind speed and 5400 Pascal snow load.
- The height of the solar modules from the ground has to be minimum 70 cm.
- The maximum height of the solar modules from the ground has to permit easy cleaning.
- The mounting structure has to be designed according to minimum 25 years life of the system and resist against oxidation, corrosion and erosion from sand particles and sand storms.
- All the connections must be water and dust resistant and substantial against impacts.
- The solar panels have to be fixed to the mounting structures with adequate clamps. The holes on the solar panels cannot be used to assembly with screws.
- Isolation has to be used to prevent electrolytic oxidation when necessary.

- During the construction, if the galvanization and colours are damaged, these damages have to be repaired by Contractor.
- There has to be enough space between solar panels to facilitate resistance to wind.

### 8.2.4. Inverters

Inverters are required to be procured from a well-known and financially strong manufacturer in order to ensure relevant long term warranty

Inverters are also required to be:

- String type
- High Efficiency at > 98% (EURO Efficiency)
- Outdoor prepared and sturdy able to resist to sand storms (IP65)
- With good heat dissipating ability
- Having service capability in Afghanistan or in neighboring country
- Reactive Power (VAR) Adjustable
- Approved by Power company in Afghanistan Or compatible with the Herat DABS grid
- Having inverter track record in similar reference projects
- Inverter size shall be at least 20 kW, but preferably bigger, up to 60 kW.
- The inverter shall have several inputs so the strings are connected directly to the inverter input, avoiding the use of DC combiner boxes. If DC combiner boxes are needed it shall be from the same manufacturer than the inverter.

Minimum inverter guarantee of five (5) years is required Extended warranty of fifteen (15) years shall be proposed as optional

Inverters will be placed outdoor. A small roof or pergola will be placed on top to protect them from heavy sun radiation (temperature).

### 8.2.5. Monitoring

A monitoring system shall be installed so the PV plant can be monitored both locally and remotely.
Monitoring system shall have communications with Internet through satellite or mobile network.
The system will include a weather station. The station should be shared with the wind farm. This system shall be capable to monitor each inverter and to read weather station and bidirectional meter values.
From each inverter the system shall give current data of each of the DC inputs. If DC combiner boxes are used, then also these boxes shall be accessed by the monitoring system to retrieve data from each string.

### 8.2.6. LV Electrical Technical Requirements

Contractor is responsible for the procurement and assembling of the cables which will be used between solar panels, solar panels-inverters, inverter-transformation, transformation-grid, and grounding cables.

#### 8.2.6.1. DC electrical Requirements

Cables shall be compliant to most recent standards developed by the IEC and EN for UV resistant DC cables for solar PV applications. The string cable shall have PV1-F certificate of TÜV.

- The operating temperature range of the cables has to be -40°C/+85°C and they have to resist until 120°C.
- Cables shall be designed for a nominal DC voltage of 0.6/1.0 kV, and UV, ozone and high temperature resistant.
- Conductors shall be electrolytic grade high conductivity annealed tinned copper. Conductors shall be multi stranded, smooth, uniform in quality and free from scale and other defects.
- Cables up to 16 mm2 shall be tied along the solar PV module mounting structures.
- Total DC Ohmic losses shall not exceed 1,5%
- Nominal cross section of cables is to be approved by TUV, and according to IEC 60228 and IEC 60287 standards.
- No DC Junction boxes shall be required in principle.
- All DC cables shall be installed in conduits rather than direct buried.
- Solar cable connections have to be connected using MC4 type plug and socket.

The Offeror has to include the data sheets of the cables they propose in the tender file.

#### 8.2.6.2. AC electrical Requirements

- The AC cables have to have TSE standard certificate and be produced according to TS IEC 60502 standard.
- In AC-LV side of the system, 0,6/1 kV copper cables have to be used. (Between inverters- AC combiner boxes “GDP” and AC combiner boxes-main AC box “ADP”)
- The cable route for buried cables, cable excavation, and cable design has to be in conformity with the terms of the Afghan norms.

- The floor of the cable tray has to be smooth, compressed and cleared from the stones, etc. which could harm the system.
- The maximum operating temperature of the AC cables has to be 70°C.
- All the AC cables used in the system have to have the cross-section which would limit voltage loss to a maximum of 1,5%.
- The Offeror has to include the data sheets of the cables they propose in the tender file.

#### 8.2.6.3. Grounding

- All the electrical and electronic equipment used in the solar system, cabins, construction products, all the solar panels and all the support structures have to be grounded.
- The grounding, the procurement of the materials and laboring cost are the responsibility of the Contractor.
- The grounding, the procurement of the materials and laboring of the grounding have to be in line with the current project design of the system to be approved by DABS.
- All the modifications which will be required by DABS have to be complied by the Contractor at no extra cost.

### 8.2.7. MV Electrical Installation

- In MV side of the system 36 kV Al XLPE cables have to be used.
- The Transformer building shall include the following components:
- LV board with protections for each line coming from inverters, and 1 general bidirectional meter.
- Step-up transformer (20.0 kV)
- Transformer Protection Switchgear with circuit breaker
- Input Protection Switchgear with circuit breaker
- Cabling (interconnection between all devices)
- Electrical equipment requirements as per DABS standards

### 8.2.8. Video Surveillance System

The PV plant shall have a video surveillance system along the perimeter of the site. This system shall include cameras able to automatically generate alarms in case someone/something crosses the fence. The system shall be capable to send the alarms to both, a local security room and a remotely surveillance center. This system shall be also able to work during night time (IR cameras and lights).

### 8.2.9. Building

The design of the plant shall include a building with 3 rooms, one for the control room, one for the guards another one for spare parts, and a toilet.

Size of this building shall be at least 7 x 3.5 meters.

### 8.2.10. Labeling

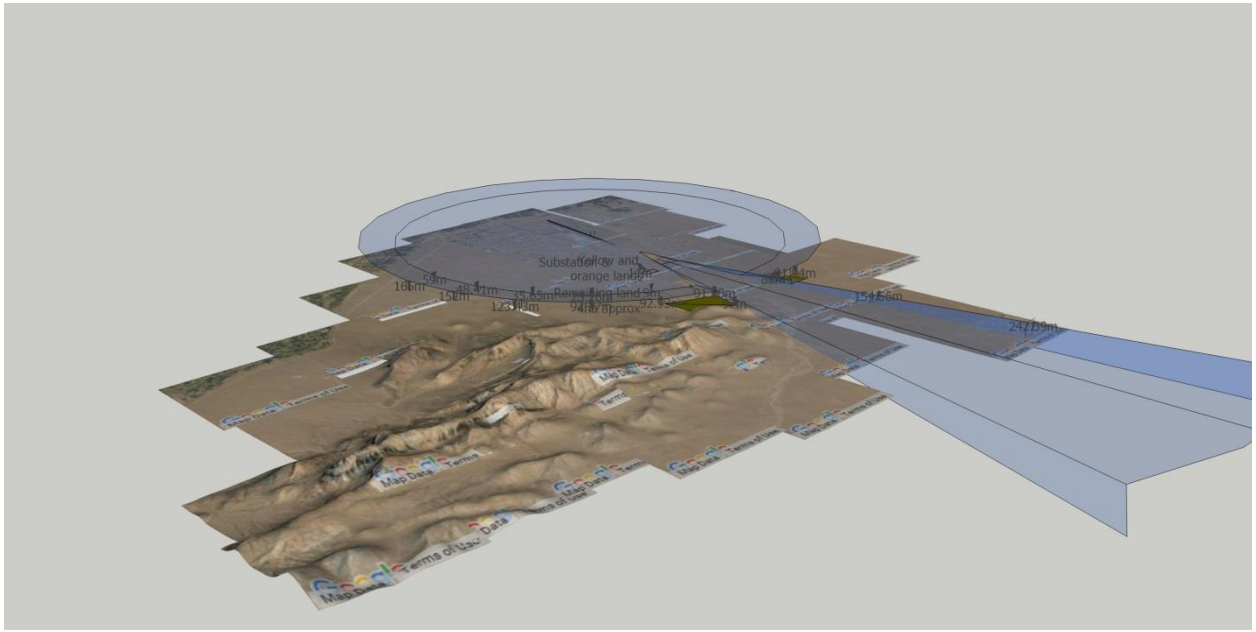
All stations, cabinets, boards, table rows, cables, protections and switches shall be labeled.

The labels shall be durable weather resistant and UV resistant.

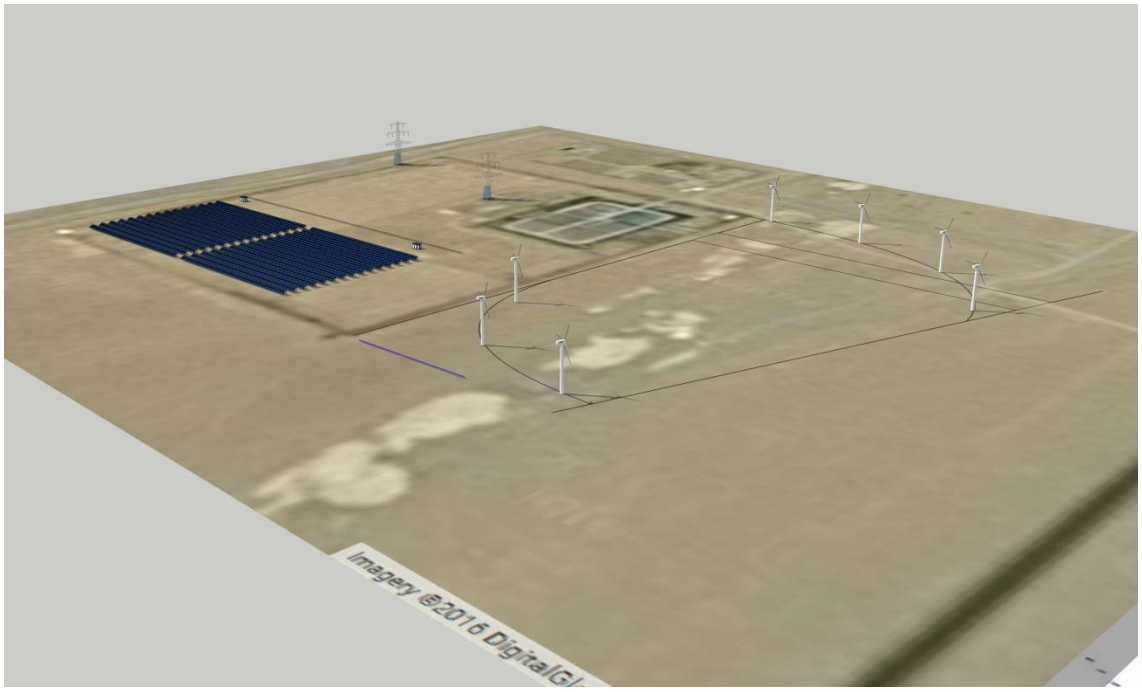
## 8.3. Wind Farm

### 8.3.1. Location

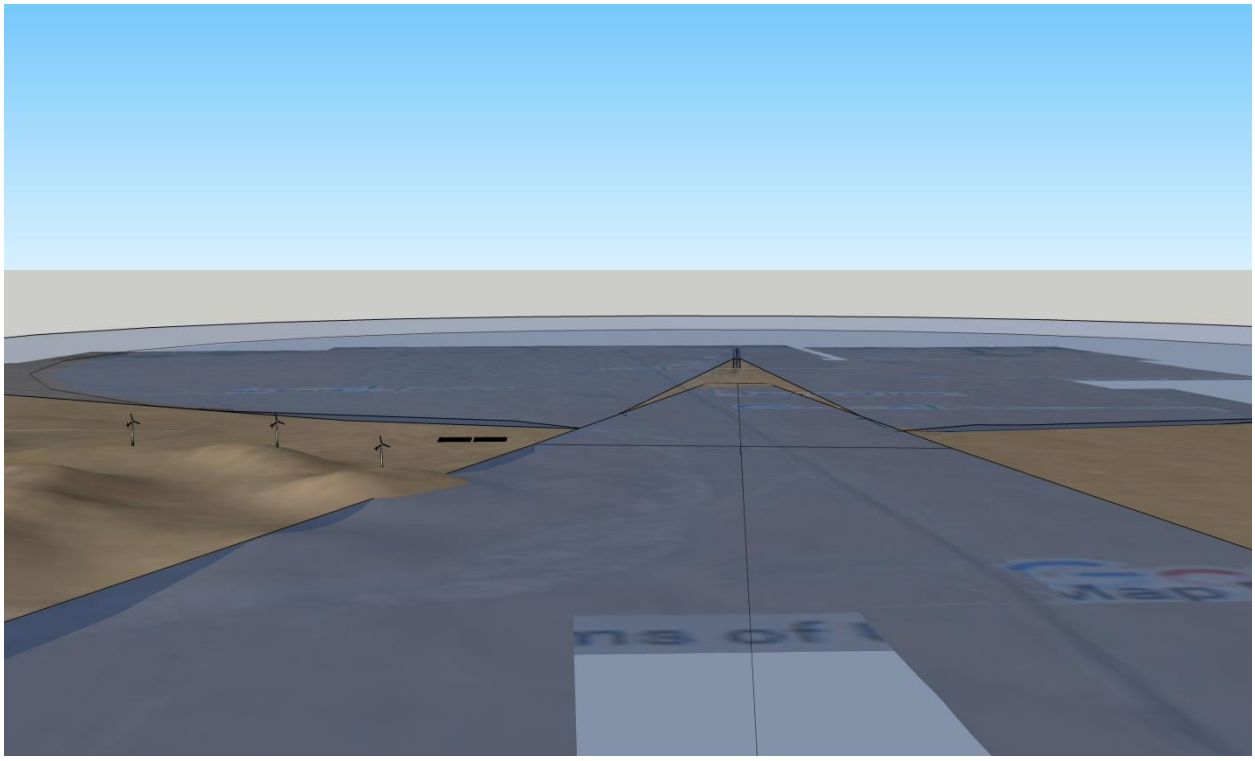
Under ICAO rules and in order to guarantee aircraft safety, the Herat International Airport has a number of construction restrictions in its surroundings.



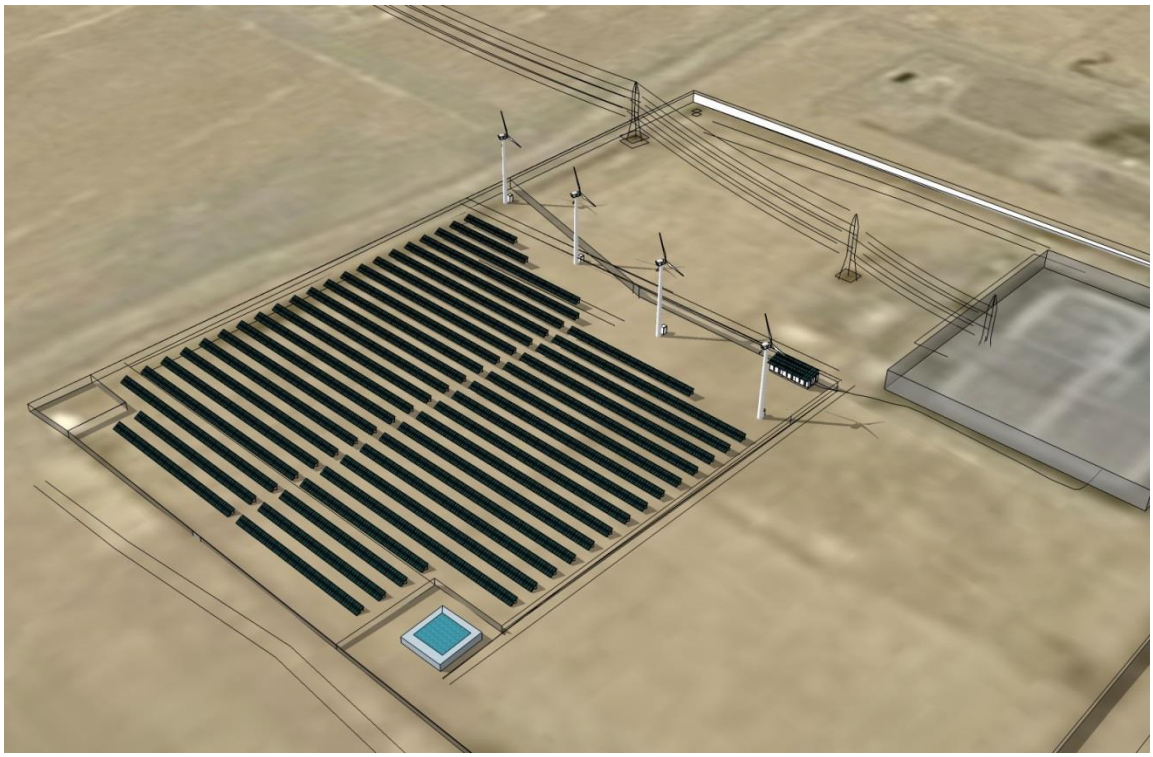
**Site A** (image below) is located inside of the 8km diameter circle called inner horizontal obstacle prevention surface. In this area construction height is restricted to 45m, however due to altitude differences between the runway and site A, we are in fact limited to 35m total height.




**Site B** (image below) is outside of the airport's obstacle prevention surfaces, so there are no administrative restrictions there. In addition the wind resource should be better. However it is farther away, more difficult of access, and the terrain is very rocky.



**Site C** (image below) is inside the substation together with the solar field. The space is somewhat tight but allows a more coherent design of the plant. In addition turbine maximum height is of 40m.



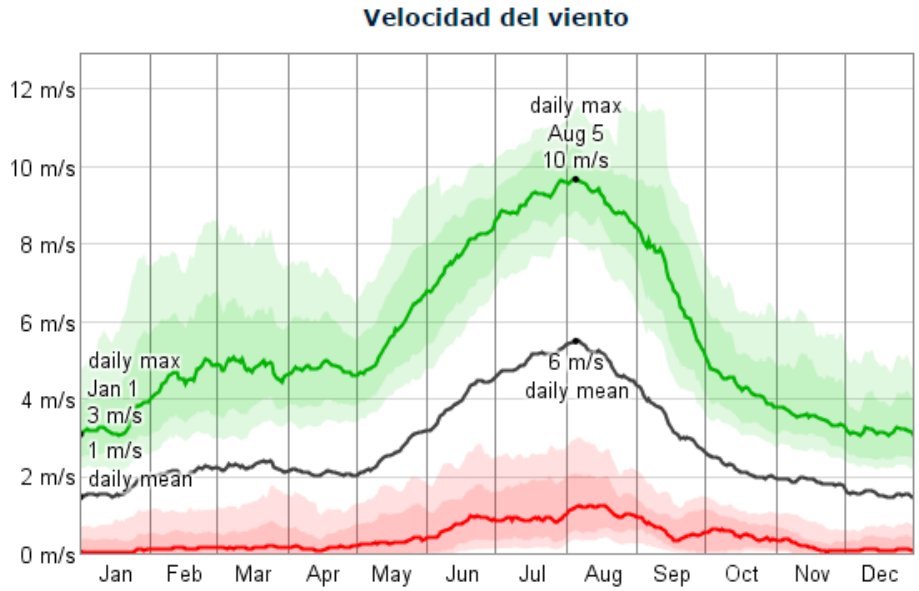
### 8.3.2. Wind resource

#### 8.3.2.1. From the Herat Airport weather station

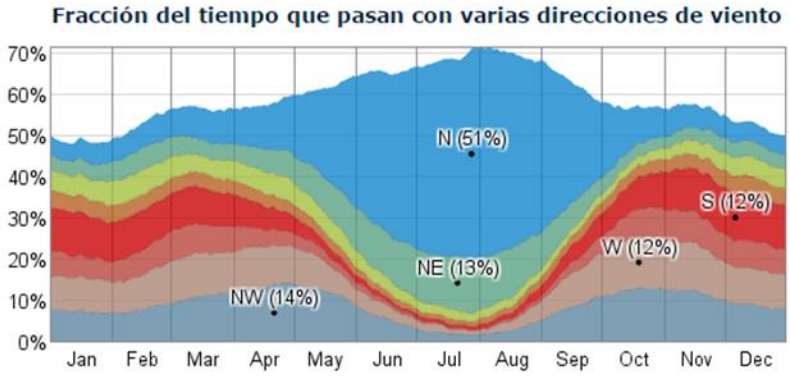
Orographic characteristics of the territory and location are favorable to the production of wind energy, although the wind behavior is very irregular throughout the year.

The territory is characterized by a high wind potential as interpreted in the rose speeds, even though it is necessary to take the data carefully since some of this data refers to the specific airport and others refers to measurements taken several kilometers from the site.

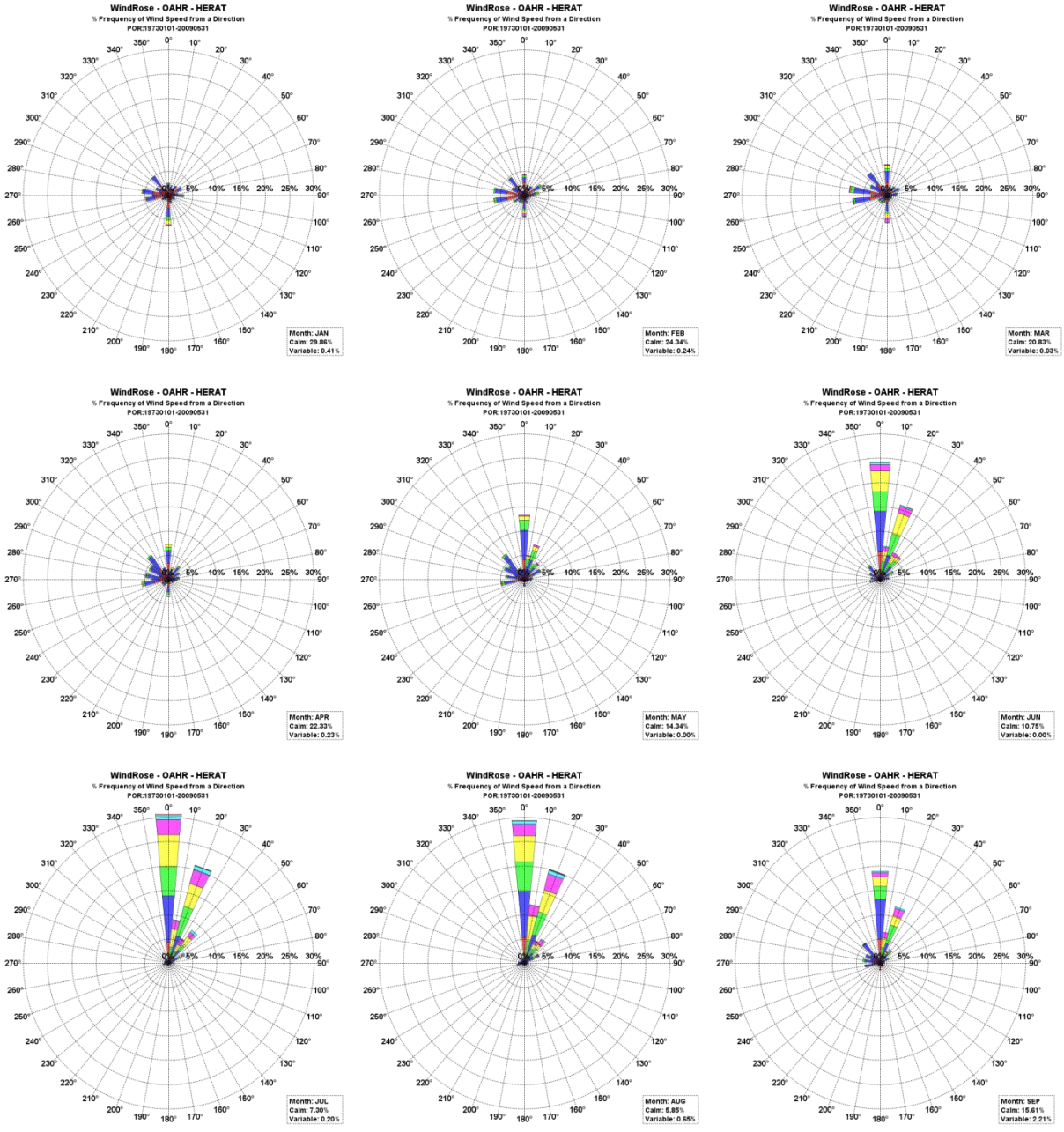
At the airport in Heart, in the course of the years typical wind speeds range from 0 m / s to 10 m / s, rarely exceed 12 m / s (strong breeze).

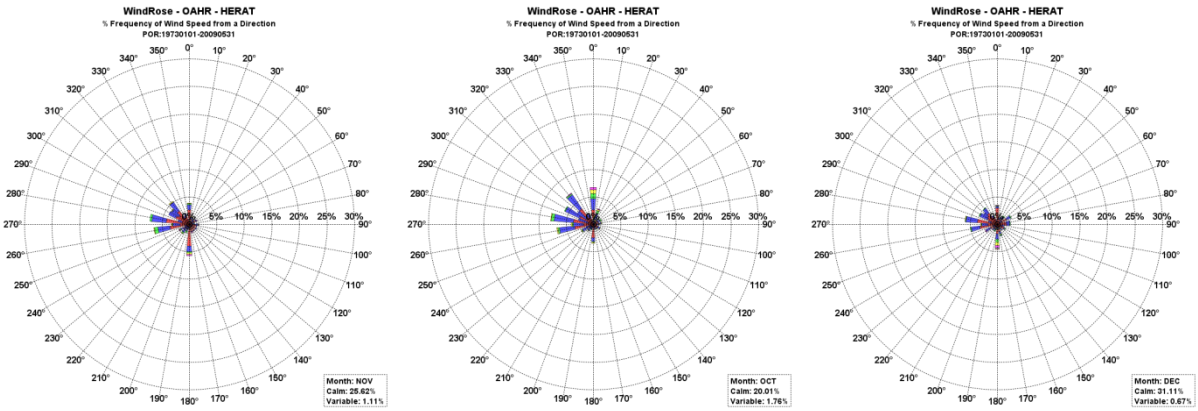


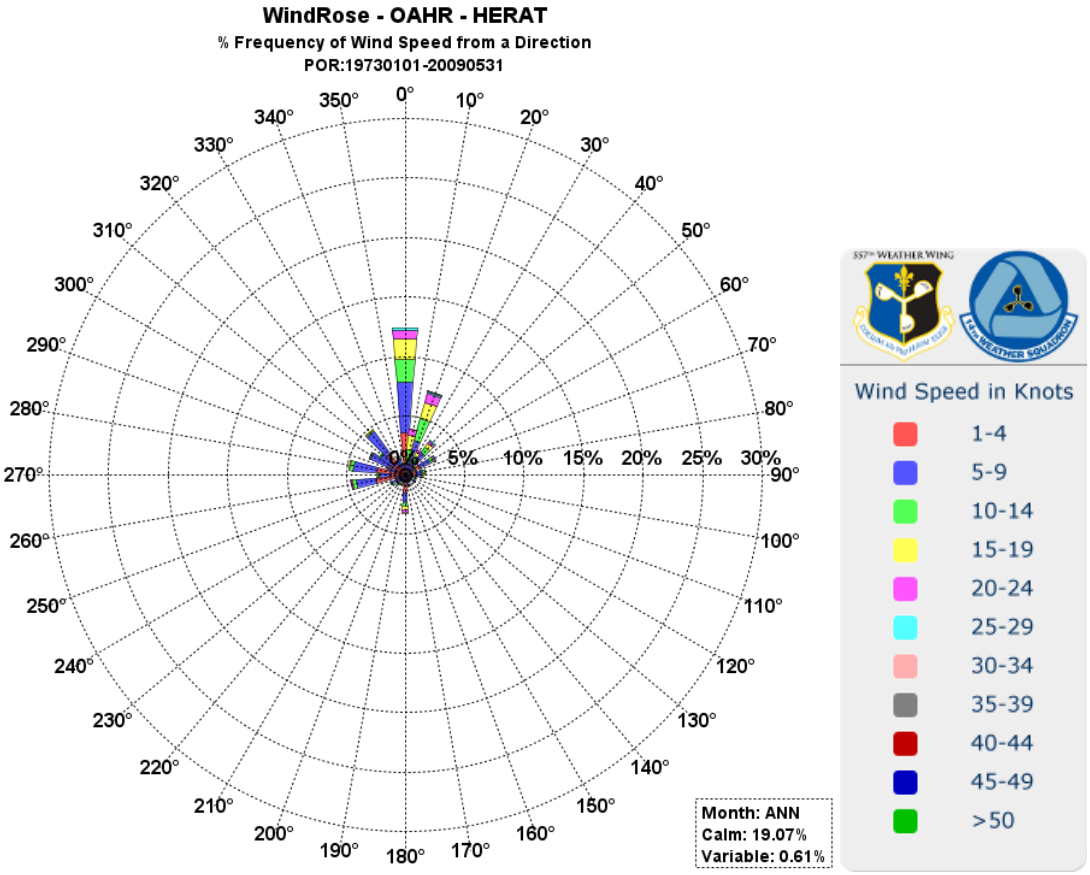

*La mínima media diaria (rojo), máximo (verde), y (negro) velocidad media del viento con bandas de percentil (interior de la banda del 25 al 75 por ciento, banda exterior del 10 al percentil 90).*



The fraction of time spent with the wind blowing from different directions throughout the year. .

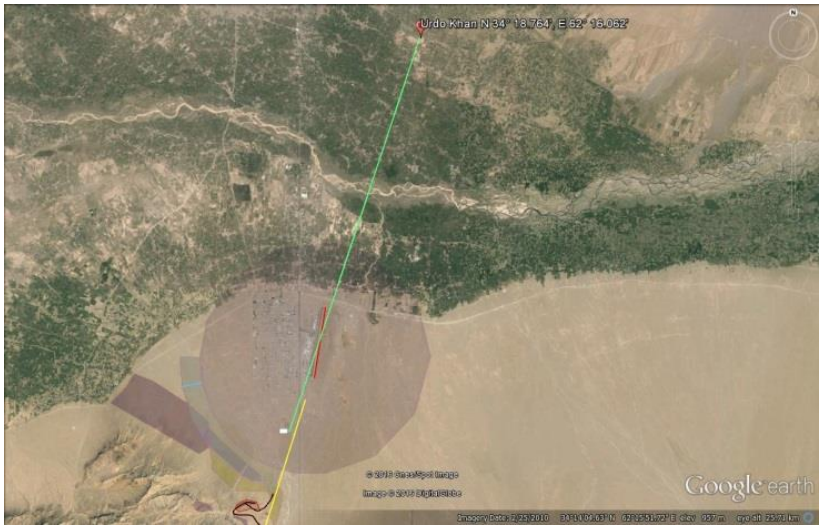


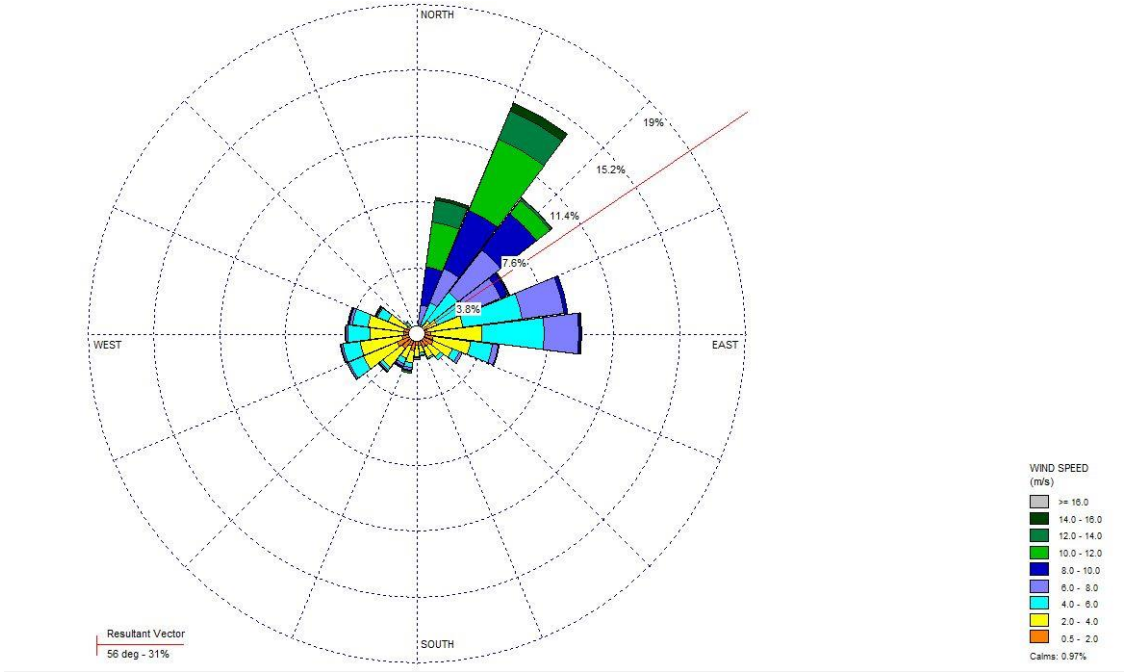


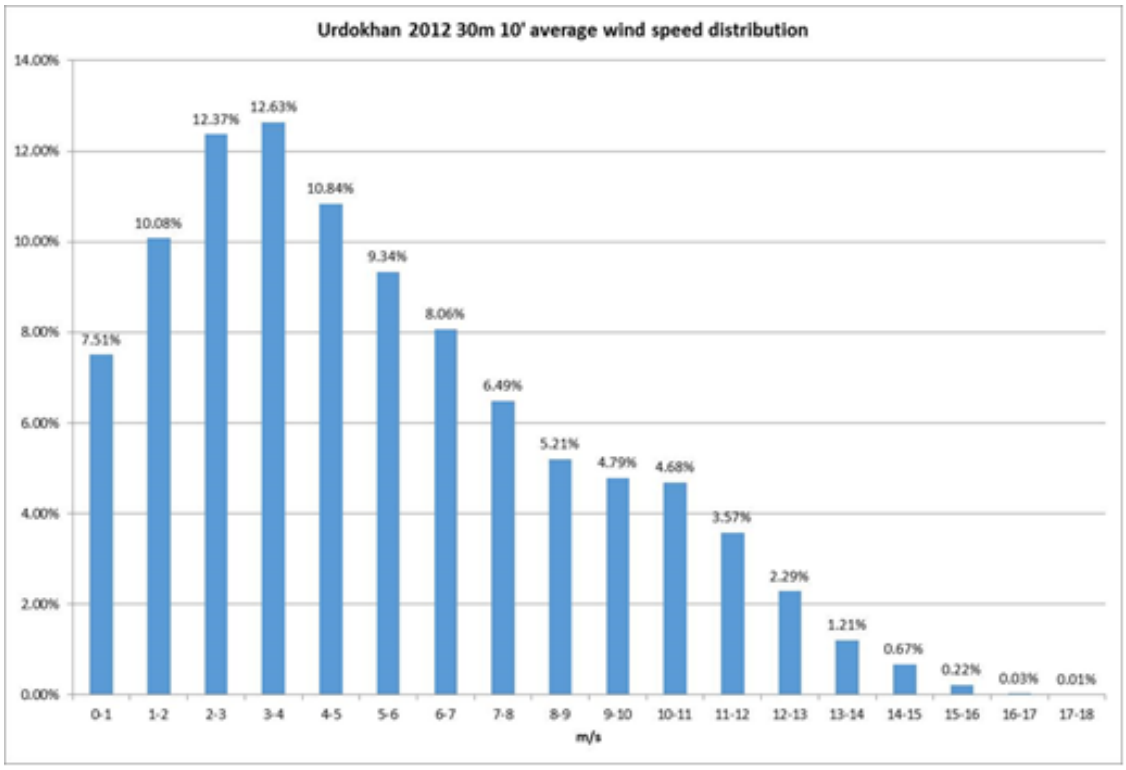

### 8.3.2.2. From the Urdokhan measuring tower

The Urdokhan meteorological tower is located 15.2 km from the substation, at 945 meters, 197 degrees NNE. Just across the airport in the direction of the prevailing wind. Site A, DABS Substation, is at 1020 m, ie we are 75m higher. The airport is 3km from DABS Substation and 12.2 km of Urdokhan, and about 990 m. The attached map is more explanatory from this site unfortunately we only have one year data (2012), but on that basis the following was extracted.

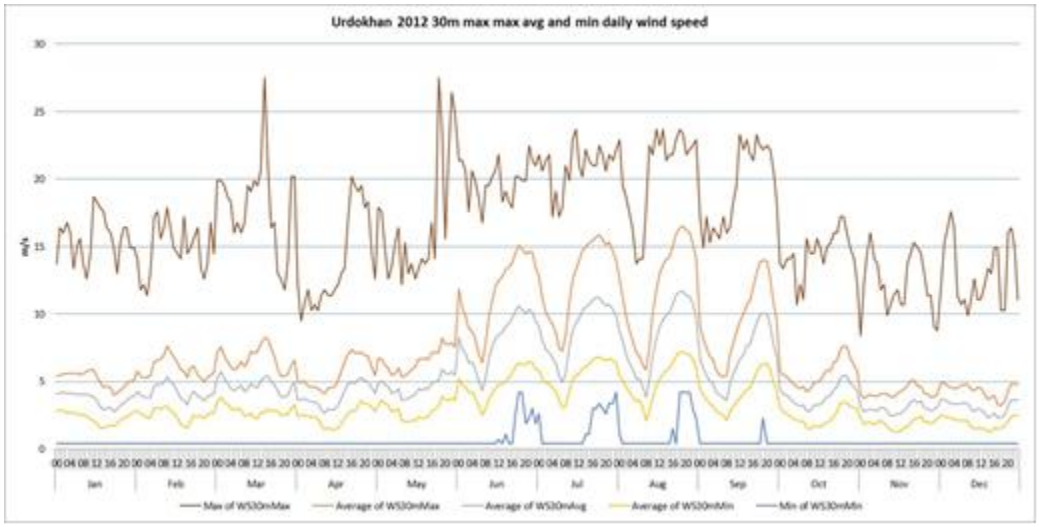



Urdokhan 2012 data 30m wind rose




Related behavior gusts of wind can be seen in the following graph:




More details on climate characteristics can be found in Annex xxx

### 8.3.3. Wind farm

As indicated above the wind farm can be located in one of two alternatives sites.

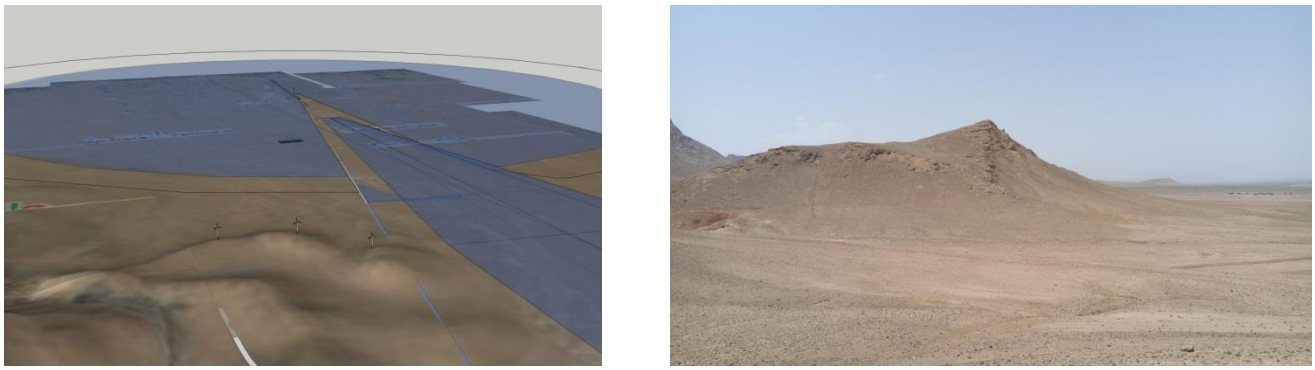
#### *8.3.3.1. Site A*

Located adjacent to the substation, this site benefits from much easy access and shorter evacuation line. However, wind resource will be inferior and construction height is restricted to 35m total. Also the terrain is limited in size, to the west by the substation and some aerial electric lines, to the east by the boundary of the airport's approach obstacle prevention surface, surface, and in its upper middle there are also some electric lines that. Finally, the land will require some preparation including refill and compacting.

Conceptual design and picture of site A

#### *8.3.3.2. Site B*

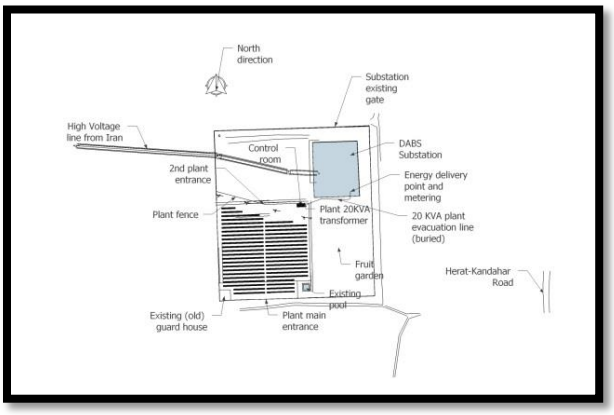
Located on the hills south of the Industrial Zone, this area benefits from better wind potential and is free from any height construction limitation. However, the access is difficult and the soil is rocky, so placing wind turbines there may require some substantial civil works. In addition the MV evacuation line will need to be 2.5 to 3.0 km long.

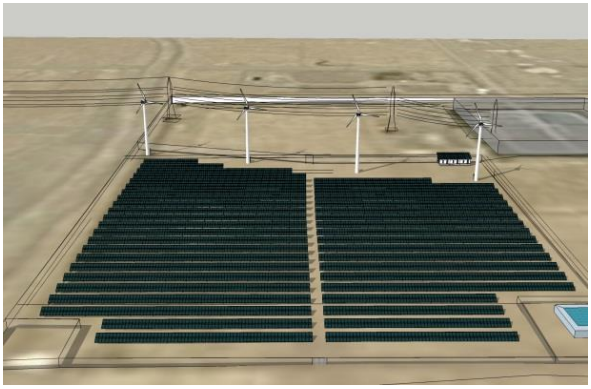


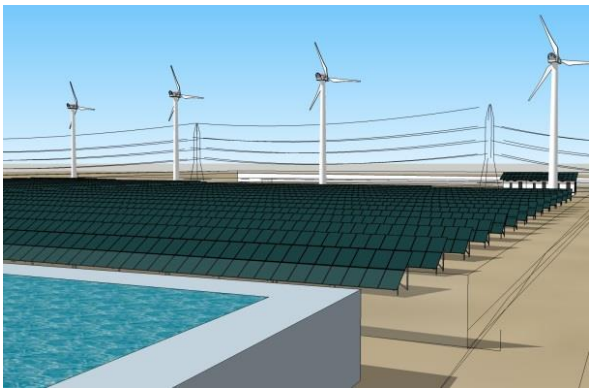
Conceptual design and picture of site B seen from the west (more pictures in annex)

### *8.3.3.3. Site C*

Site C is located inside of the Substation compound; this is the same terrain as for the Solar Park.





## 8.3.4. Total and unit power to install in the wind farm

- The total power of installation depends on the configuration.
- Offerors are free to propose the configuration they wish (PV/wind), provided the wind is not inferior to 250kW, and the solar not inferior to 1.2 MWp.
- The height of towers is in each case are the standard of each manufacturer.
- Likewise the foundations must meet manufacturer's specifications, and must take into account the geotechnical study as well as the 50 year wind gusts.

### 8.3.5. Occupied land area and location of wind turbines and independent anemometer tower

- The area of wind for each wind turbine sensitivity is defined as the area bounded by a contour area, whose vertices are the intersection points that would be generated by drawing two lines parallel to the direction of the prevailing wind at a distance of two (2) diameters lines both sides of the rotor shaft, and two lines perpendicular to the wind direction, one pass at a distance of eight (8) diameters of the symmetry axis of the shaft of the wind turbine to leeward and another at a distance of eight (8) diameters windward.
- In the area of wind sensitivity should be avoided constructions of any kind to prevent disturbance of the wind flow throughout the useful life of the facilities.
- In the event the selected installation elevation wheelbase wind turbine a single row will be 3 times the diameter of the proposed wind turbine.

Wind turbines should be distributed according to several fundamental criteria:

- Optimal use of the land, obtaining the highest performance thereof as wind estimated parameters,
- Respect the minimum distances of separation between wind turbines that will be up to three times the diameter of the rotors used, or if this is possible and at least twice the diameter, not to hinder the activity of the area
- Noise.

Each Offeror must calculate the equivalent hours and the capacity factor of its proposal, being

- **Equivalent Hours**: The hours equivalent is an intuitive concept, used to indicate the number of hours per year that a farm turbine should work at their rated power for an equivalent annual energy production to energy (kWh/kW).
- **Capacity Factor:** It is a parameter that expresses the efficiency and is calculated as the ratio between the hours equivalent wind farm and hours / year.
- **Availability:** is a parameter that measures the annual percentage time relative to 8760 h in which a wind turbine or a wind turbine installation consisting of several is able to operate.

### 8.3.6. Technology

The choice of wind turbine model and technology must respond to the best combination of the various parameters to consider, which include:

- Wind turbine with high unit power, combined with optimal dimension of the rotor allowing maximized ground use. This parameter has been called power density.
- Power curves and adapting the machine to the specific site conditions, wind regime.
- High energy efficiency.
- Pass technology and variable speed.
- Power generated, adapted to the site, within the allowable values for adaptability to weak networks.
- Guarantees of the availability coefficient around 98%, understanding the availability coefficient as the percentage of annual time that machines are in technical conditions to generate.
- Power control and monitoring of grid parameters. Power controlled through the systems of variable blade incidence and rotation speed enables wind generators to operate at maximum efficiency, while reducing or eliminating undesired power peaks. This guarantees a good conversion efficiency as well as the high quality of electricity supplied to the grid.
- The blades will be adapted to de angle system and variable speed, minimizing the turbulence effects and dirt in the attack edge. The blades will be protected from environmental influences through an outer coating resistant to abrasion and solar radiation.
- The pitch angle should be adjusted in a short time with maximum precision depending on the prevailing wind conditions.
- The elastic load changes should reduce mechanical stress and wind turbine material aging and its isolation. Variable speed and adjusting blade pitch will clearly reduce mechanical torque peaks.
- Each provider will propose its best “flexible” connection between the generator and the network so that sudden changes in electrical generation involving moderate changes in the delivery network are amortized.
- Wind turbines electricity production (typically 400 V to 650 V three-phase) should be elevated to 20kV by the means of one or more transformers, in order to match the voltage of the grid connection point. .
- It will be appreciated that in voltage drops (network problems) the wind turbines will remain for a few seconds connected to the network instead of disconnect directly, once the system voltage recovered return to deliver immediately full power to the network.
- The facility will be equipped with a capacitor bank so that the cosine of phi is equal to one with the condition that this value may deviate from the default value just before network stability requirements; in that case deliver reactive power to the network would be possible.
- The voltage and frequency set by the distributor company in the territory of implementation are respected.
- Safety braking: The security system must ensure a completely aerodynamic braking during operation, orienting the blades to feather position in the shortest time possible. The rotation speed of the turbine must be reduced without the transmission system receiving any additional overhead.

- To prevent the excessive fatigue of blades, bearings and drive, it is proposed that the rotor turns at low speed during periods of no network connection, locking the rotor only in emergency stops or to develop maintenance actions.
- Intrinsic safety is one in which before any type of failure (mechanical electrical or electronic control) the wind turbine is fully braked, orienting the blades to feather position and the wind turbine in the prevailing wind direction.
- Grounding and lightning protection: Wind turbines are exposed to internal and external electrical influences. The set of internal influences include accidental short circuits or earth contacts in electrical components. The set of external influences include overvoltage caused by lightning or switching operations and interconnection lines. These influences can cause the destruction of electrical installations and in the worst case; endanger the lives of the people who operate these systems.
- To protect the installation of these situations, each machine will have a lightning protection system that diverts the potential impacts to ground through wires located around the foundation, without damage to the turbine.
- In the event that the impact of lightning or an unusual increase in voltage (overvoltage) occurs, all electrical and electronic equipment must remain firmly protected by integrated structural parts that absorb energy.
- In the main connection of the wind turbine further surge arresters that are grounded with low impedance will be installed. The electronic components of the wind turbine will be galvanically isolated and placed in metal housings.
- Additionally wind turbine electrical components must be protected against electromagnetic fields and superior interference voltages.
- Sensors and wind turbine control: All related to safety functions: the rotor speed, wind direction and speed, temperature, loads, oscillations, coiled cables, etc will be monitored by sensors. If one of these sensors registers a serious disturbance, the wind turbine will be disconnected immediately automatically.
- The automatic boot process will be activated if a stable and sufficient wind speed to turbine operation for three to five consecutive minutes is warranted. The control electronics should allow a smooth start in any wind condition.
- When the nominal speed wind power is reached or exceeded, power to the nominal value will be maintained by adjusting the angle of the blades and the rotor speed to reach the cutting speed defined by the manufacturer. In changing incident wind situations, rotor revolution and the pitch angle of the blades must continually adapt.
- The nacelle yaw system must operate before reaching the threshold starting speed, being able to adapt the blade pitch angle to the existing wind speed before completing the orientation of the wind turbine.
- Each wind turbine should have is own wind vane and anemometer mounted in the nacelle. Such systems must be thermally insulated and may be redundant.
- Unrolling of the power cables and control: These cables must be attached to the wall of the tower and admit a maximum of three full turns in the same direction of rotation. When the cables reach the maximum

authorized turns the control system will use the next period with weak wind to return to unroll. If the wind is not weaker before admitting a quarter turn in the same direction motivated by change of wind direction or any other cause, it breaking the wind turbine blades putting in feather position, rotate to orient new cable replacing stable position and begin again its operation.

- Each Offeror will include in his proposal an extremely clear operations manual with instructions for wind turbine control, that includes the following modes of operation:
    - If a sensor affecting security is enabled, it will launch an automatic shutdown procedure. The wind turbine can be started only after an in depth appreciation of what happened.
    - Recognition procedure of primary faults involved in the wind turbine stop.
    - Recognition procedure of secondary faults that can be reset once tested and may or may not involve the automatic shutdown of the turbine. The wind turbine can automatically put itself back into operation if the detected defect has been recognized and canceled by authorized personnel, both in local and ir remote control.
    - Aerodynamic losses and production gain: management of spinner blades eliminate the effect of loss of lift and the increased rotor speed optimizes production increased to elevation wind speed.
    - In case of danger to people or to the components found in the turbine, it must be able to stop quickly through pressing an emergency stop button.
- Certifications: All electrical and control characteristics of the selected wind turbine must be certified by agencies or laboratories internationally recognized. The same applies to performance curves and useful life pronostics.

### 8.3.7. Basic data of the wind turbine(s)

The wind turbines proposed must meet the following characteristics:
**Unit nominal power**: from 60 kW to 1500 kW
**Rotor diameter**: proper relationship between SUp/nominal Power to resist summer winds.
**Tower height**: minimum 20 m and the appropriate to each turbine according to the chosen location.
**IEC class wind turbine**: IA, or the one indicated by the supplier according to their wind studies.
**Design useful life**: minimum 20 years.
**Cut-in wind speed**: 2,5 to 3,5 m/s
**Rated wind speed**: 10m/s to 14 m/s (static), 12 to 15 m/s (dynamic)
**Cut-out wind speed** (average of 5 s); 28 to 34 m/s
**Rotor pitch control**: Upwind type with angle control active step, or downwind.
**Rotation direction**: all the same
**Number of blades**: 2 or 3 (3 preferably)
**Swept area**: according selected turbine.
**Composition of the blade**: reinforced epoxy with fiberglass or better.

**Rotation speed**: variable between 14 and 44 rpm.
**Top speed**: depending on the chosen rotor (m/s)
**Cone angle**: according to design.
**Inclination angle**: 2 to 4 degrees in principle
**Pitch control**: electromechanical control system of each blade for each individual blade or as set all blades.
**Slewing ring**: Bearing or roller bearings on a stationary position.
**Generator**: preferably synchronous with direct coupling.
**Power network**: frequency and current with sine wave form.
**Grid Frequency**: 50 Hertz
**Conventional breaking system**: independent system of blades with angle control with essential energy supply, mechanical motor break, motor lock and mechanical rotation break and yaw drive.
**Intrinsically safe**: wind turbines should auto-stop when all systems and communications fail, bringing the blades to feather position maintaining minimal rotation of the rotor or break it.
**Tower painting**: epoxy dual layer sand blasted surface.
**Obstruction flashing lighting** for aircrafts has to be installed as per ICAO rules

### 8.3.8. Electrical works at MV

Grid data on the site and Electric substation power delivery:

- The Owner of the wind farm has a connection point provided by the Grid Operator which offers the conditions for connection of the wind installation.
- The connection voltage is 20 kV
- The wind farm and the PV plant will each connect to the grid separately
- Proposals to achieve greater stabilization of the system, since in the field of tertiary network control systems can help major generation of it to maintain its qualitative level of performance will be evaluated. Therefore the proposals for carrying out improvement actions to ensure the stability of the electrical system are taken into account.

### 8.3.9. Monitoring and control

- Wind turbines must be equipped with a remote control system and SCADA (System Control and Data Acquisition)
- The telecommunication of each equipment will depend on the resources available, and can be performed either via radio, mobile telephony, or satellite.
- Each turbine will have a central control system that should perform the following actions:
    - Active Control of energy delivered to the system
    - The control system may order each machine in the farm to vary its nominal power according to the command received. This can range from all off, up to the maximum rated power of the machines, according to the command received.
    - Control of reactive power will depend on the existing wind and upper limit imposed by the apparent power of the equipment.
    - The control system may order the park each machine to vary its power factor. The limit of variation in the capacitive and inductive sense depend on the active power shots, and maximum apparent power of the equipment

The SCADA system is used for data acquisition, remote control, open loop and closed loop control for wind turbines and wind farm.

- It allows the client and service to monitor the operating status and analyze service data saved by the turbines and grid connection.
- The SCADA system must also provide additional options to perform closed loop control (eg power factor at the Point of Common Coupling).

***8.3.9.1. Below are the minimum requirements of all you must provide the SCADA system:***

- The wind farm SCADA assumes control functions internal closed or open loop, data storage and communication with the outside world.
- You must have a program for monitoring and display of supported operating data with the database remotely. If the access authorization for intervention in the operation is provided, it must also be possible that certain operating parameters can be modified.
- You must have a system used for exchanging values of the wind turbine system in line with the points of external communication, some of which are the settings setpoint network operators to wind farm and export the operating data.
- incorporate a system for measuring all electric current values at the Point of Common Coupling
- A control unit of the substation used for acquiring the current states of voltage transformation within the substation for remote switching operation therein.
- A voltage control system for dynamic control of voltage at the point of common coupling.
- A system for the acquisition of meteorological data (wind speed, wind direction, etc.) both from the turbines and using a separate meteorological tower located near the plant.

The SCADA software on the PC SCADA wind farm covers numerous functions, including:

- Request status data of all connected installations (wind turbines, time measurement equipment, data acquisition network, etc.)
- Data storage service
- Communication of wind farms with external communication points (owner, operator network, etc.)
- Open / closed loop control of electrical output values of the wind farm loop

- Special control for a group of wind turbines in the installation (for example, start or stop depending on the weather, wind conditions or temperatures, status data, other facilities, such as photovoltaic if necessary)
- The online connection must be permanently available so that service data are updated and transmitted to remote SCADA software with maximum transfer speed of the connection line. With telecommunications connections through stable conventional fixed networks, remote PC screen installed must be updated at least once per second.
- Other data recorded in the wind turbine are recorded and analyzed in the control system of the turbine and will be available when required by the services of O&M.
- Data transformation substation, external meteorological tower, including the PV system must be able to be integrated into the SCADA system installed.
- All other operating data are generated by the control system of the wind turbine as average values for one minute and inform the SCADA PC. Moreover, the minimum and maximum speeds, power values and wind speed that occur per minute also sent to the SCADA PC.
- All operating data and messages from the SCADA system must be stored on a PC hard drive. This unit must have sufficient capacity to store all data collected for at least 10 years. Once 90% of hard disk capacity is reached, the SCADA system will issue a warning message.

#### 8.3.9.2. Control parameters of the power grid

- The grid parameters such as voltage, current and frequency must be measured continuously and transmitted to the control system to enable the turbine to react immediately to fluctuations in the voltage and frequency of the network.
- If the limit values of the protection system are exceeded, the turbine must stop and inform.
- The turbines should automatically return to normal operating mode as soon as the voltage and frequency return to their default values permissible.

#### 8.3.9.3. Reducing the power output of the wind farm

- The management system used should allow a reduction in the power output of between 0 and 100% of the nominal power of the installation.

#### 8.3.9.4. Control of the turbines at high wind speeds

- The technology must avoid shutdown and automatic braking at high wind speeds in less than a minute with the consequent destabilization of the system, assessing that this occurs with slower response by adjusting power delivery network by controlling blade pitch and variable speed.

#### 8.3.9.5. Power gradient

- To prevent surges against from large fluctuations of wind some pre-selected values of power gradients should be automatically adjusted.
- The turbines must be equipped with electronic starters, thyristor bridge or the like to reduce the inrush current at startup so this will not fall more than 20% of the rated current

## 8.4. Grid Connection and metering

From each installation (solar and wind) there will be a transmission line to the existing DABS substation. In DABS substation there will be one switchgear for each transmission line. These transmission lines will at 20 kV level.

The length of those transmission lines will be around 200 m each, alternatively or some 2.7 km if the wind generators are installed on site B.

These lines shall be buried for the solar Park and wind site A, and aerial if wind site B is chosen, and shall follow DABS requirements and Afghan regulations and standards.

Electricity production meters shall be installed on each of the power delivery lines, in the substation. In addition consumption meters shall be installed in the circuits supplying power for the two plant auxiliaries.

The final connection to the grid will be done by DABS, but the Contractor needs to provide the necessary components to do so (MV cables, connectors and 2 switches notably).

## 8.5. Operation and Maintenance

The Offeror is welcome to include in his offer a proposal for the Operation and Maintenance of both, the PV and the wind installations, for a period of 5 years.

The proposal shall define detailed tasks, frequency and Service Level Agreement. Anyhow Solar Plant Availability shall be ≥ 98%.

Contractually speaking the Operation and Maintenance activities are not part of this procurement contract. However the Operations and Management proposal as well as its cost will be a welcome addition to the offers.

# Annex A of the TOR – Other information

**(Attached)**

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