# *ANNEX II + III:* TECHNICAL SPECIFICATIONS + TECHNICAL OFFER

**Contract title:**

Procurement of photovoltaic equipment for the Secondary Industrial schools of Nablus, Jenin, Deir Dibwan.

Engineering, Procurement and Construction of a grid-connected photovoltaic system for the Secondary Industrial School of Tulkarem.

**Publication reference:** VIS/004/MAE/2018/1PAL449 (1-2 Lot)

**Columns 1-2 should be completed under the supervision of VIS organisation**

**Columns 3-4 should be completed by the tenderer**

**Column 5 is reserved for the evaluation committee**

Annex - the Contractor's technical offer

The tenderers are requested to complete the template on the next pages:

* Column 2 is completed by technics under the supervision of VIS organisation and shows the required specifications (not to be modified by the tenderer),
* Column 3 is to be filled in by the tenderer and must detail what is offered (for example the words “compliant” or “yes” are not sufficient)
* Column 4 allows the tenderer to make comments on its proposed supply and to make eventual references to the documentation

The eventual documentation supplied should clearly indicate (highlight, mark) the models offered and the options included, if any, so that the evaluators can see the exact configuration. Offers that do not permit to identify precisely the models and the specifications may be rejected by the evaluation committee.

The offer must be clear enough to allow the evaluators to make an easy comparison between the requested specifications and the offeredspecifications.

**Objectives of the photovoltaic on and off grid plants**

**Lot 1.** Procurement and delivery only of photovoltaic equipment for the Secondary Industrial schools of Nablus, Jenin, Deir Dibwan.

* 1. All the materials shall be of the best quality and suitable for tropical conditions.
  2. Tenderers shall fill in all blanks in the tender and schedules to the specification and shall submit with their tender a complete set of detailed drawings and catalogues.
  3. Two years Replacement warranty is required of any Delivered Device, in the case that the manufacturer warranty is not voided.

**Lot 2**. Engineering, Procurement and Construction of a grid-connected photovoltaic system for the Secondary Industrial School of Tulkarem.

* 1. The scheme involved the adding a rooftop photovoltaic system and production of electricity using solar energy for own use and reducing electricity consumption.
  2. The design and construction of the photovoltaic system shall be in accordance with the latest appropriate I.E.C. roles and standards taking into consideration Tulkarem Municipality technical regulations for Solar Systems.
  3. An Engineering, procurement and construction (EPC) contract will be held with the contractor for the construction of solar PV power plant: The contractor is engaged to carry out the detailed engineering design of the project, procure all the equipment and materials necessary, and then construct and commission the plant for the client. In addition, the contractor commits to delivering the completed plant for a guaranteed price and by a guaranteed date and furthermore that the completed plant must perform to a guaranteed level. Failure to comply with any of these requirements will usually result in the contractor having to pay financial compensation to the owner in the form of liquidated damages (Lds).
  4. All the materials shall be of the best quality and suitable for tropical conditions.
  5. Tenderers shall fill in all blanks in the tender and schedules to the specification and shall submit with their tender a complete set of detailed drawings and catalogues.
  6. A two-years Warranty Period O&M for the Tulkarem system is included in the offered price, also Two years Replacement warranty is required of any Delivered Device.
  7. Training for the local staff

# Subject: Tender for Industrial schools PV-Grid Connected Photovoltaic System or Delivery Subject

You are kindly invited to bid for the delivery of Solar PV equipment for the 3 Industrial Secondary Schools of Jenin, Nablus and Deir Dibwan, and for the design, supply, delivery and installation of a grid connected Photovoltaic system specified in relevant tables attached for the Tulkarem Industrial Secondary School. The design and construction of the PV system shall be in accordance with the latest appropriate I.E.C. roles and standards taking into consideration Tulkarem Municipality regulations. All the materials shall be of the best quality and suitable for tropical conditions. The tendered shall fill in all blanks in the tender and schedules to the specification and shall submit with their tender a complete set of detailed drawings and catalogues.

The Bid Package should include four separate envelopes for: Offered prices, Bid Bond, Catalogues, Complete design. Any bid package without the above will be neglected.

# Lots and EPC contracts

The project has been divided into 2-lots. An Engineering, procurement and construction (EPC) contract will be held with each contractor for the construction of solar PV power plants.

LOT 1

* LOT 1-A: DDIS Deir Dibwan Industrial School in Ramallah Supply & Delivery
* LOT 1-B: Nablus Industrial School Supply & Delivery
* LOT 1-C: Jenin Industrial School Supply & Delivery

LOT 2

* Tulkarem Industrial School Grid-Tie Installation 5 kWp, Supply & Delivery & Installation & Commissioning.

The contractor is engaged to carry out the detailed engineering design of the project, procure all the equipment and materials necessary, and then construct and commission the plant for the client. In addition, the contractor commits to delivering the completed plant for a guaranteed price and by a guaranteed date and furthermore that the completed plant must perform to a guaranteed level. Failure to comply with any of these requirements will usually result in the contractor having to pay financial compensation to the owner in the form of liquidated damages (LDs).

It is not the intent to specify completely herein all the details of design and construction of equipments**.** However, the PV-System shall conform in all respects to the high standard of design & workmanship and be capable of performing in continuous commercial operation up to tenderer’s guarantee in a manner acceptable to purchaser, who will interpret the meanings of drawing and specification and shall have the power to reject any work or material which in his judgment are not in accordance with requirements**.** The equipment offered shall be complete with all parts, necessary for their effective and trouble-free operation. Such components shall be deemed to be within the scope of supply, irrespective whether they are specifically brought out in the commercial order or not.

Consideration may be given by the purchaser to alternatives which the supplier considers advisable by reason of his own manufacturing requirements and experience, provided descriptive matter is submitted pointing out the recommended device or arrangements equal to or superior to that required by the accompanying specification with full justification.

# Standard

All materials and equipment shall comply in all respect with the requirements of the latest editions of the relevant IEC Standards**.** Alternatively, all materials and equipments shall be designed and manufactured in accordance with IEC or TÜV Standards. The PV system of Tulkarem Industrial School shall be designed and connected to the grid in accordance with Tulkarem Municipality requirements besides the requirements in the tender, Technical Regulations for Solar Systems and Surplus Net Metering. The PV system supplies the building load and exports any excess energy to the grid. When there is insufficient sunlight to generate power (e.g., at night) the building load needs are met by energy imports from the grid. A bi-directional meter is installed to measure and record the net result.

# Scope of work

**For Lot.1**

The contractor must only deliver to the site and give the two-year replacement warranty of defected Items within manufacturer’s warranty.

**For Lot 2.**

The works include supplies and services described into the present document, all the works of the profession necessary for the perfect and complete functioning of the installations.

The contractor shall be responsible for all the procurements and services required for the installations in order to perform perfectly and fulfill their complete functioning requirements according to the state of the Art rules and standards.

The contractor’s scope of work should include all supervision, management, labor, plant equipment, temporary works and materials required to complete the works, including:

• Plant design.

• PV modules.

• Inverters.

• Mounting structures, including piled or ballasted foundations.

• DC cabling. DC protection

• AC cabling.

• Switchgear.

• DC and AC Switching, protection and isolation

• Grid connection interface.

• Earthing and lightning protection.

• Metering equipment.

• Monitoring equipment.

• Permanent security system.

• Temporary onsite security during construction.

• Temporary and permanent site works, including provision of water and power.

• Permanent access tracks (both internal and external).

• Site drainage.

• Plant commissioning.

• Handover documentation (including as-built drawings, O&M manual and commissioning certificates).

• Spare parts package.

The contractor's works include, but is not limited to [note: detailed design must be mentioned] include:

* The procurement and the installation of all the elements of the photovoltaic system (equipments and materials) :
* Their delivery to sites;
* The tenderer should take in consideration the pre-implementation cost of the system for preparing the location of the system installation from any obstructions and difficulties relative to the sites accesses, in coordination with the municipality staff or the Salesian community. The tenderer shall commit himself to provide any specific tools for access and mounting of the PV systems.
* Their implementation and their connecting;
* The setting of all the equipment/material/components and devices needed for the proper implementation and operation of the installations
* The electrical completion tests, the provisional and final site integration and acceptance tests;
* 2 Year EPC Warranty Period: The tenderer should include in the offered price the warranty period O&M for the system
* ***Option:*** The tenderer should include in the offered price preventive and curative maintenance for the system for two years
* Installation plans and drawings, cabling and routing plans

The contractor will also have to supply and install the off-concession equipments, especially cabling of the PV electrical system to the building existing Low Voltage distribution Board.

* The photovoltaic field feeds the receivers in service
* All the recommended capacities have to insure to allow to insure a maximum of availability of electrical energy. The system is designed to allow a maximal electric supply security.
* The sizing is made so that the solar production compensates for the consumption of the receivers, without using electricity distribution network, so that the electrical distribution network remains a feedback solution.
* The Performance Ratio is the parameter used to quantify the PV plant performance.

# EPC Construction Phase and Handover Protocol: Key Milestones

Key Milestones shall include but are not limited to:

* Designated Contractor: This date corresponds to the end of call for tender, and the nomination of the selected Contractor.
* Contract Signature: This date corresponds to the end of Contract negotiation phase, upon which the contract signature takes place.

The following is only for **LOT 2**.

## Construction

All the listed plans, schedules and documents (see §6) shall be sent 30 calendar days after the contract signature for discussion and approval. The review shall be held within 2 weeks after the key milestone date.

Provided below is the basic required procedures in addition to a list of recommended actions

* Contract, fully signed and reviewed by technical advisor covering all interfaces.
* Design documentation completed
* Detailed programme of works completed.
* Quality plan completed.
* Health and safety plan completed.
* Monthly reporting in place.
* Commissioning and testing plan agreed to by all parties, detailing requirements and any tests needing witnesses or sign-off.
* Interface matrix drawn up.
* Deliverables schedule prepared for all documentation.
* Weekly look-ahead programme in place.
* Risk register detailing all potential risks and any mitigation measures in place.
* Environmental plan completed.
* Monthly report structure completed.
* Matrix detailing the requirements and due dates prepared.

## Mechanical Completion

Refers to the stage whereby all principal sub-components forming the final power plant have been installed and are mechanically and structurally complete. Inspection the works by the owner in order to compile an initial list of construction defects (referred to as a “punch list”). At this date, all the forecasted tests concerning the civil and infrastructure, waterproofing and mechanical engineering works shall be successfully completed, and the corresponding completion certificates issued. Mechanical completion allows for commissioning activities to commence.

## Commissioning

Commissioning should prove three main criteria:

1. The power plant is structurally and electrically safe.

2. The power plant is sufficiently robust (structurally and electrically) to operate for the specified lifetime.

3. The power plant operates as designed and its performance falls in line with pre-determined parameters.

Critical elements of a PV power plant that require commissioning include:

1. PV module strings.

2. Inverters.

4. Switchgear.

5. Lightning protection systems.

6. Earthing protection systems.

7. Electrical protection systems.

8. Grid connection compliance protection and disconnection systems.

9. Monitoring systems (including meteorological sensors).

10. Support structure and tracking systems (where employed).

11. Security systems.

Commissioning Tests includes but is not limited to:

Prior to connecting the power plant to the grid, electrical continuity and conductivity of the plant’s various subcomponents should be thoroughly checked by the contractor (or specialist electrical subcontractor). Once mechanically and electrically complete, the following tests should be conducted on all module strings and on the DC side of the inverters:

• Polarity Check: The polarity of all DC cables should be checked. This is one of the simplest and most important safety commissioning tests. Several rooftop fires involving PV systems have been traced back to reverse polarity.

• Open Circuit Voltage (Voc) Test: This test checks whether all strings are properly connected and whether all modules are producing the voltage level as per the module data sheet. The Voc of each string should be recorded and compared with temperature-adjusted theoretical values. For plants with multiple identical strings, voltages between strings should be compared to detect anomalies during stable irradiance conditions. Values from individual strings should fall within 5 percent of each other.

• Short Circuit Current Test (Isc): This test verifies whether all strings are properly connected and the modules are producing the expected current. The Isc of each string should be recorded and compared with temperature-adjusted theoretical values. For plants with multiple identical strings, voltages between strings should be compared to detect anomalies during stable irradiance conditions. Values from individual strings should fall within 5 percent of each other.

• Insulation Resistance Test: The insulation resistance of all DC and AC cabling installed should be tested with a megohmmeter. The purpose of the test is to verify the electrical continuity of the conductor and verify the integrity of its insulation.

• Earth Continuity Check: Where protective or bonding conductors are fitted on the DC side, such as bonding of the array frame, an electrical continuity test should be carried out on all such conductors. The connection to the main earthing terminal should also be verified. After the above commissioning tests have been successfully completed and the correct functioning and safe operation of subsystems have been demonstrated, commissioning of the inverters may commence. The inverter manufacturer’s directions for initial start-up should always be adhered to.

Grid Connection Interface

Grid connection should only be performed once all DC string testing has been completed. The distribution system operator will witness the connection of the grid and/or the protection relay. Such a preference should be agreed in advance as part of the connection agreement.

The grid connection agreement stipulates requirements, such as electrical protection, disconnection and fault, to which the solar PV power plant is required to adhere. These conditions should be met and demonstrated before commissioning the grid connection interface and energization of the plant.

General Commissioning Recommendations

Commissioning activities should commence following mechanical completion of the plant’s various subcomponents or, where appropriate, sequentially as module strings are connected.

Since irradiance has an impact on performance, commissioning should be carried out under stable sky conditions and ideally at irradiance levels above 500W/m2.

The temperature of the cells within the modules should be recorded in addition to the irradiance and time during all testing.

Commissioning activities should incorporate both visual inspection and functional testing.

Test results should be recorded as part of a signed-off commissioning record. The contractor is expected to carry out these tests and make aware the owner. The required documentation is completed, submitted and recorded.

The contractor shall provide the opportunity to the Client and any representatives of the Client to witness all commissioning tests, compliant with all applicable Health&Safety procedures.

At this date, PV mechanical and Low Voltage (<1000V) electrical installation testing shall be fully completed and a Mechanical and Electrical Engineering Certificate of Compliance issued. A set of video and photos shall be sent with the certificate of Compliance.

## Provisional acceptance

At this stage, the contractor has complied with all of its construction-related obligations and the plant is ready to be handed over to the owner. The criteria for achieving provisional acceptance should be clearly outlined in the contract and may include:

• Mechanical completion having taken place in accordance with the agreed technical specification and the plant being free from defects (other than noncritical punch list items).

• The aggregate value of the punch list items does not exceed a 2 percent of the contract price.

• Grid connection and energization of the plant have been achieved.

• All commissioning tests have been successfully completed.

• The provisional acceptance performance ratio (PR) test has been passed.

• All equipment and sub-contractor warranties have been assigned to the project company.

• All handover documentation is in place and hard and soft copies provided to the owner.

• Operation and maintenance training of the owner’s personnel has taken place.

• Any delay or performance-related liquidated damages (LDs) incurred by the contractor during the construction phase have been paid to the owner.

• Any performance bond required during the EPC warranty period has been delivered to the owner.

A this date, the overall PV installation Acceptance Tests, including mechanical, electrical and communication testing, shall be successfully completed. At this date, all the required documents, softwares and testing proofs shall be sent to the client and submitted to the client approval.

The provisional acceptance date would also mark the commencement of the contractor’s EPC warranty period, which lasts for 24 months.

Performance ratio testing

To granting provisional acceptance, the completed plant will perform in line with the contractually agreed criteria (in terms of output, efficiency and reliability) and through testing of the plant’s PR.

A PR test period at the stage of provisional acceptance would be for a minimum of 15 consecutive days of continuous testing. It is desirable to test plant efficiency and reliability over a range of meteorological conditions.

The PR required is 80%.

Calculation of the plant PR is determined using the contractually agreed formulae.

The PR measured over the test period should be compared against the guaranteed value stated in the contract. If the measured PR exceeds the guaranteed value then the test is passed. If the measured PR is below the guaranteed value, the contractor should perform investigations into the reasons for plant under-performance and rectify these prior to repeating the test.

LDs (Liquidated Damages) are instead linked to the results of the annual PR tests measured at the end of one year of plant operation.

Intermediate and final acceptance

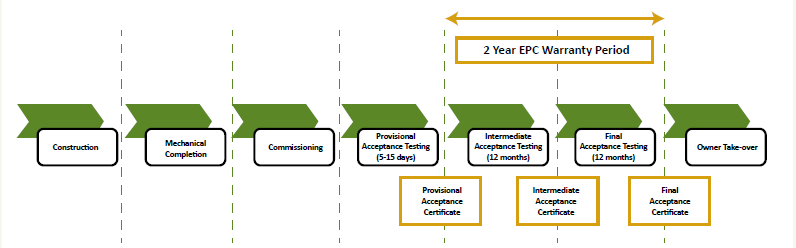
The contractor will typically be required to deliver a number of guarantees in relation to their works. These are described below.

• **Defects Warranty:** the contractor should provide a fully-wrapped plant defects warranty for a period of at least two years following the date of provisional acceptance. The contractor is responsible for the rectification of any defects that may be identified during this period.

• **Performance Warranty:** In addition to the shortterm PR test at provisional acceptance, the contractor should provide a PR guarantee to be measured at one or two separate occasions within the defects warranty period. The PR should be tested annually over the first year and then over the second year of plant operation.

PR testing over the first year of operation is referred to as the intermediate acceptance test. PR testing during the second year of plant operation is referred to as final acceptance testing. If these performance tests are passed (along with other contractual conditions) then an Intermediate Acceptance Certificate (IAC) and Final Acceptance Certificate (FAC) may be signed.

**EPC Construction Phase and Handover Protocol**



# Contractor obligations

**For Both LOTs:**

## Qualities of materials

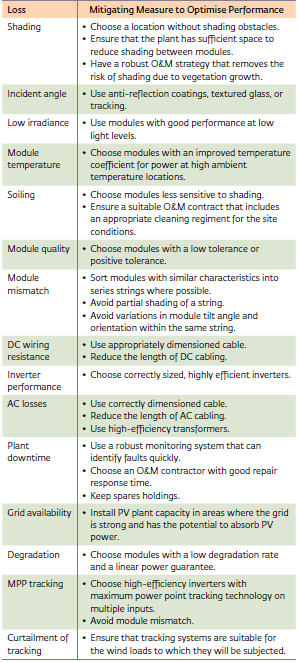
The design, the materials and the manufacturing quality equipment will have to be in accordance with the most recent national or international corresponding standards. All the materials, the devices and diverse accessories used in the installations must be new and top-quality.

**For LOT 2 Only.**

## Optimizing system design

The performance of a PV power plant may be optimized by a combination of several enabling actors: premium modules and inverters, a good system design with high quality and correctly-installed components and a good preventative maintenance and monitoring regime leading to low operational faults.

The aim is to minimize losses. Measures to achieve this are described in table below. The tenderer-designer shall make suitable compromises that result in a plant with a high performance at a reasonable cost according to the local conditions. The ultimate aim of the tenderer-designer is to create a plant that maximizes financial.



# Documentation Requirements

**For LOT 1.**

Detailed Datasheets and (manuals Later) for all of the delivered equipment and tools, indicating the model Type and quantity supplied.

**For LOT 2.**

## Development of Detailed PV Design

The EPC contractor will prepare the necessary detail documentation for the solar PV plant to be tendered and constructed. The following documentation will be prepared:

• Detailed layout design.

• Detailed civil design (buildings, foundations, drainage, access roads).

• Detailed electrical design.

• Revised energy yield.

• Construction plans.

• Any mechanical tools and logistics needed for site accesses and rooftop installation

• Project schedule (includes orders and supply schedule, tasks and delays for each lot including procurement milestones, deliverables and key milestones)

• Interface matrix.

• Commissioning plans.

Key electrical systems must be designed in rigorous detail. This will include equipment required for protection, earthing and interconnection to the grid. The following designs and specifications should be prepared:

• Overall single line diagrams.

• Medium voltage (MV) and low voltage (LV) switch gear line diagrams.

• Protection systems.

• Interconnection systems and design.

• Control systems.

Civil engineering items should be developed to a level suitable for construction. These will include designs of array foundations and buildings, as well as roads and infrastructure required for implementation and operation. The design basis criteria should be determined in accordance with national standards and site specific constraints such as geotechnical conditions. For example wind loadings should be calculated to ensure that the design will be suitable for the project location.

• Quality Plan: shall include the quality requirements and the full list of applicable international standards. The tenderer shall invariably furnish the following information along with his offer, failing which the offer shall be liable for rejection**.** Information shall be separately given for individual type of equipment offered.

• Health & Safety Particular Plan: shall include all the working requirements concerning health and safety, according to applicable international regulations.

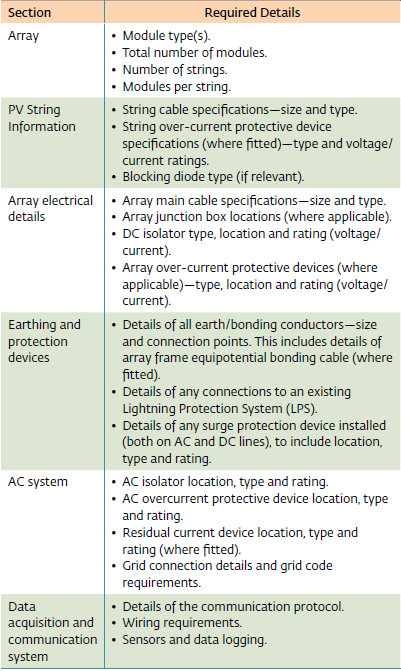
**Design Documentation Requirements**

There are a number of minimum requirements that should be included as part of design documentation. These include:

• Datasheets of modules, inverters, array mounting system and other system components.

• Manufacturer application notes and specifications of the procured equipment (with the certificate of compliance in the standard relative to the inverter)

• Wiring diagrams including, as a minimum, the information laid out in the figure below.



• Layout drawings showing the row spacing and location of site infrastructure.

• Mounting structure drawings with structural calculations reviewed and certified by a licensed engineer.

• A detailed resource assessment and energy yield prediction.

• A design report that will include information on the site location, site characteristics, solar resource, design work, energy yield prediction, and a summary of the results of the geotechnical survey.

The site map of the system including PV panels, inverters, metering units and electrical panels should include:

• Electrical Drawings including detailed routing paths

• Location and nature of the diverse pathway: Nature, arrangement, lengths, and sections of electrical conductors in continuous and alternative currents

• Calculation notes for: Sizing of the electric protections, AC and DC voltage drops, Mechanical strength of the support structure, Line losses at nominal power of the photovoltaic system

• Conduct a solar shading study of the PV field at the proposed array location, per month, providing simulation results at various points across the PV solar area, and resulting power calculations

• Grounding system scheme: grounding method, grounding bridge and the connections between parts

## After commissioning / Before Provisional Acceptance

Commercial operation commences after commissioning, which includes performance and reliability tests specified in the contract. Such tests may be conducted for individual components and then for the overall system. Component by-component testing is always needed, in order to assess whether each contractor has fulfilled its obligations.

Successful tests are usually a trigger to release payments to the contractor(s). Unsuccessful tests may result in design modifications, and even legal action if the PV plant cannot meet performance and reliability guarantees.

Upon completion of acceptance tests, the contractor should provide the plant owner with “hand-over documentation,” which should include design data, drawings, O&M procedures, information about spare parts, and any other information pertinent to complete handover of the plant and its successful future operation and maintenance.

• A file of the executed works in 3 copies containing the following elements: the certificates of guarantee of the materials with their duration, all the plans and as-built electrical, structural mechanical drawing in DWG or DXF format

• A technical textbook intended for the developer in 3 copies and including:

 The description of the installation and its functioning principle. The limits of normal functioning of the system, the list of all the materials installed with data and coordinated sheets of the suppliers (addresses, telephone numbers, names of the people to contact), with the serial numbers of the main equipment (modules, inverter ...)

 Principal plans, detailed and normalized electric drawings, plans of cabling of the installation and the supplied equipment, the specifications and the technical documentations in English

 Instructions of exploitation, and maintenance with description of the operations to be made and their periodicity, the instructions for the diagnosis of the current breakdowns, the procedure of consignment (specifying the functions and the ways to access to the organs of consignment) of the installation and its commissioning, the list of necessary extra spare parts, list of special tools or any necessary equipment for the assembly, the regulation, the functioning and the maintenance of the materials, the software of exploitation of the power plant of data acquisition

## Before Intermediate and Final Acceptance

Documents requirement includes but is not limited to:

• Drawings conformed to International Standards Organization in soft and hard copies

 Engineering Plan: shall include logistics, civil, infrastructure, mechanical, electrical and communication aspects.

 List of components with ratings.

 Detailed Design Document : shall include calculation notes, power estimates, simulations, software parameters, selected materials and equipment specifications (data sheet of equipments), circuit diagram of equipments, dimensional drawing of equipments.

 Infrastructure plans.

 The site map of the system including (PV panels, Inverters, metering units and electrical panels).

 Grounding system scheme which shows the grounding method, grounding bridge and the connections between the parts.

 Mechanical and Electrical set of drawings

• **Testing and commissioning documents:** shall describe the full testing and commissioning phase during the Commissioning, Intermediate Acceptance Testing and Final Acceptance Testing reviews.

• **All Test Reports** shall cover the full set of requirements including civil, infrastructure, mechanical, electrical, and communication requirements, according to the contract terms.

• **Acceptance Test Plan**: shall cover the full set of requirements including civil, infrastructure, mechanical, electrical, and communication requirements, according to the applicable regulations.

• **Test Reports:** All test reports (Commissioning, Intermediate Acceptance Testing, Final Acceptance Testing) of tests conducted during manufacturing shall be submitted**.**

• **User guide** (installation and maintenance manual): includes the operator’s Technical Textbook.

Grid connected PV Installation Auto-consumption and sale of the surplus of production

General

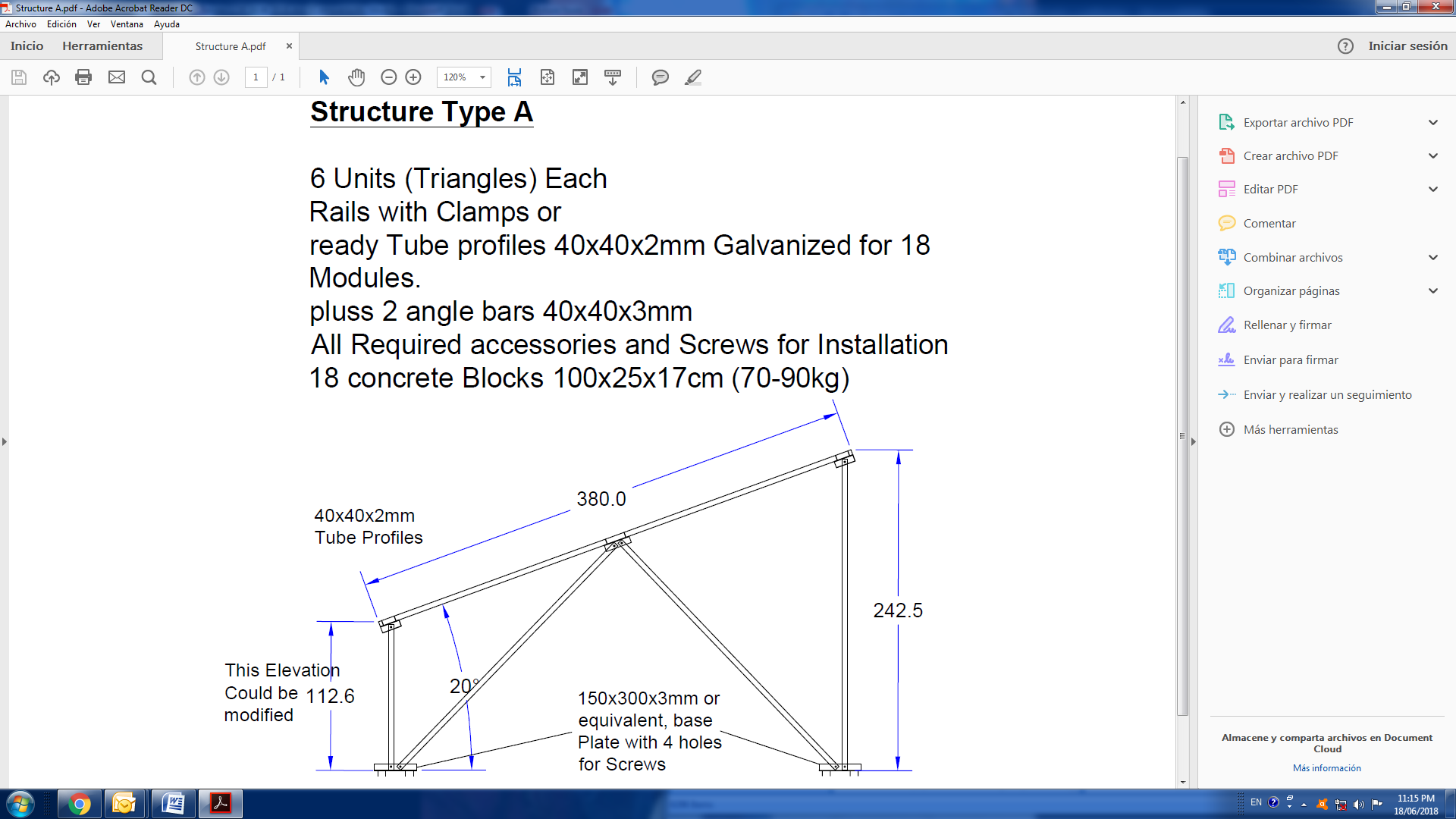
PV cable

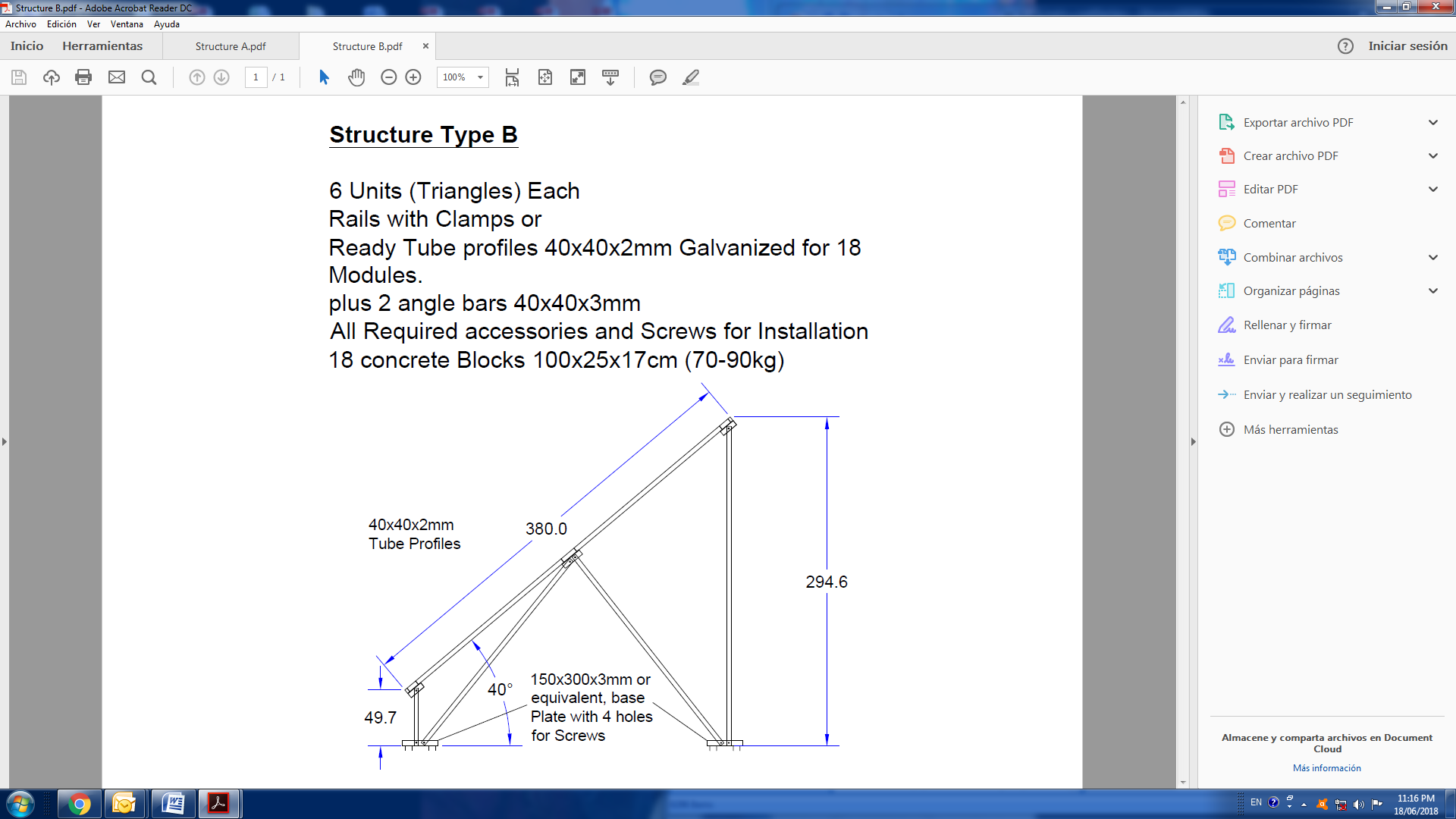
Main Earthing building

DC Surge arrestor

**Important general considerations:**

* **The number of photovoltaic plants is 1**
* **The delivery of materials will be to three different locations.**
* **All the lines must be quoted singularly**
* **The Lot 1 and Lot 2 are independent and the contractor can apply to any or both.**
* **Both single lots are indivisable, meaning that contractors may not apply for part of a Lot.**
* **The Contracting authority VIS may eliminate from the items and equipment required some of them. This has not to affect the delivery of the other items provided by the winning tenderer:**





|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **1 Item Number** | **2 Specifications Required** | **Total** | **3 Specifications Offered** | **4 Notes, remarks, ref to documentation** | **5 Evaluation Committee’s notes** |
| **LOT 1: Delivery to 3 Industrial Secondary schools** | |  |  |  |  |
| 1 | **Solar panels** |  |  |  |  |
|  | 72 cell Solar Panels, Power not less than 325Wp.Tier One, Top Ten enlisted Solar panels, PID Certification according to IE62804, 12 years workmanship warranty, 25 years production warranty. | **78** |  |  |  |
| 2 | **Structure** |  |  |  |  |
| A | Galvanized steel not less than 2mm thickness, as per attached drawings, (alternatives to withstand 120km/h wind speed are accepted after test report), prefabricated concrete blocks 3 units per triangle. Structure includes all accessories and screws and bolts and nuts and washers, Supply without Installation. suitable structure for 18 Solar Panels Inclination 20 degrees. | **2** |  |  |  |
| B | As Above, for 18 Solar Panels Inclination 40 degrees. | **2** |  |  |  |
| 3 | **Off-Grid Inverter/Charger** |  |  |  |  |
|  | Combi Inverter/Charger, 5kVA AC output Power, MPPT Charger suitable for not less than 3000Wp PV power, 92% Efficiency, Capacity to Charge Batteries from the Grid, 48VDC Nominal Voltage, 2 years warranty. | **6** |  |  |  |
| 4 | **Synchronization Kit** |  |  |  |  |
|  | Synchronization equipment suitable to connect the three Inverter/Chargers, into a 3 phase system, compatible with supplied inverter/Chargers, 2 years warranty | **3** |  |  |  |
| 5 | **Off-Grid Inverter** |  |  |  |  |
|  | 24VDC Nominal inverter, efficiency not less than 92%, output AC Not less than 1500W, NO Charger capability should be present. 2 years warranty. | **9** |  |  |  |
| 6 | **Solar Charger MPPT** |  |  |  |  |
|  | 45A Solar Battery Charger, MPPT Charging capability, adjustable Battery Nominal Voltage System 12/24/48VDC, configurable Charger Mode, 5years warranty, | **9** |  |  |  |
| 7 | **Solar Charger PWM** |  |  |  |  |
|  | 45A Solar Battery Charger, PWM Charging capability, adjustable Battery Nominal Voltage System 12/24/48VDC, configurable Charger Mode, 5years warranty, | **9** |  |  |  |
| 8 | **Solar Batteries** |  |  |  |  |
|  | Deep Cycle Battery, 100Ah@C20, 12VDC, 1000Cycle @50%DoD, 2 years warranty. | **24** |  |  |  |
| 9 | **on-grid inverter** |  |  |  |  |
|  | 2-3 kWn Grid tied string Inverter, start up and operating Voltage suitable to operate with only 6 solar panels in series, compatible with offered solar panels, 5 years warranty, Inverter with existing technical service in The country since more than 8 years. | **6** |  |  |  |
| 10 | **Monitoring Datalogger** |  |  |  |  |
|  | Capable of monitoring On-Grid Inverters, Capable of Monitoring Weather stations, 2 years warranty, Ethernet adapted, Web based monitoring. | **2** |  |  |  |
| 11 | **weather station** |  |  |  |  |
|  | Compatible with data logger, capable of monitoring Solar irradiance Tilted, and capable of monitoring horizontal Irradiance (two irradiance sensors in total), capable of monitoring wind speed, capable of monitoring ambient and panel temperature, Including all of the sensors and accessories, 5 years warranty |  |  |  |  |
| A | Irradiance sensor | **4** |  |  |  |
| B | panel temp sensor | **4** |  |  |  |
| C | Wind speed sensor | **2** |  |  |  |
| D | ambient temperature sensor | **2** |  |  |  |
|  | **Protections** |  |  |  |  |
| 12 | **Energy Meter Direct single** |  |  |  |  |
|  | single phase AC, Direct, 40A or more, unidirectional. | **8** |  |  |  |
| 13 | **Energy Meter Direct 3 phase** |  |  |  |  |
|  | three phase AC, Direct, 40A or more, unidirectional. | **8** |  |  |  |
| 14 | **Energy Meter Indirect 3 phase analyzer** |  |  |  |  |
|  | Three Phase AC, Indirect, bidirectional, analyzer, power factor, active and reactive power, clear Import and export Energy, power, current, Voltage analyze per phase. | **9** |  |  |  |
| 15 | **Current Transformer** |  |  |  |  |
|  | 5 to 60 current transformers. | **27** |  |  |  |
| 16 | **DC Breakers** |  |  |  |  |
|  | 800VDC Operating Voltage, 2 pole breakers, amp capacities |  |  |  |  |
| A | 13A | **15** |  |  |  |
| B | 40A | **9** |  |  |  |
| C | 63A | **15** |  |  |  |
| D | 100A | **9** |  |  |  |
| 17 | **DC Surge Arrester** |  |  |  |  |
|  | Type II Surge arrester, DC Compatible, Special for PV systems, 600VDC at least, 40kA. | **15** |  |  |  |
| 18 | **DC Fuse Holder** |  |  |  |  |
|  | DC Fuse Holder, up to 63A, 1000VDC, 2 Pole | **52** |  |  |  |
| 19 | **DC Fuse** |  |  |  |  |
|  | DC Fuse, 1000VDC, 16A, Cylindrical | **150** |  |  |  |
| 20 | **AC Breaker single phase** |  |  |  |  |
|  | 2 pole breaker, AC, 250VAC, curve C, amp capacities |  |  |  |  |
| A | 16A | **18** |  |  |  |
| B | 32A | **36** |  |  |  |
| 21 | **AC Breaker single phase Transfer switch** |  |  |  |  |
|  | 3 stage, 2 Pole Breaker, AC, Single Phase, 32A | **18** |  |  |  |
| 22 | **AC Surge Arrester single phase,** |  |  |  |  |
|  | 2 Pole, 40kA, Type II, single phase, | **14** |  |  |  |
| 23 | **AC Breaker 3 phase** |  |  |  |  |
|  | 4 Pole, 3 phase, AC Breaker, Curve C, Amp capacities |  |  |  |  |
| A | 16A | **18** |  |  |  |
| B | 32A | **6** |  |  |  |
| C | 50A | **6** |  |  |  |
| 24 | **AC Surge Arrester 3 phase** |  |  |  |  |
|  | 4Pole, 40kA, AC, 3 phase, Type II | **10** |  |  |  |
|  | **Boxes** |  |  |  |  |
| 25 | IP 65 Water proof box, with DIN Rails included, with buss bars included, With access to breakers without the need to un-install the cover, (breaker windows), 12 Slots | **45** |  |  |  |
| 26 | IP 65 Water proof box, with DIN Rails included, with buss bars included, With access to breakers without the need to un-install the cover, (breaker windows), 24 Slots | **33** |  |  |  |
| 27 | IP65 Water proof Box, empty, CI4, transparent cover | **15** |  |  |  |
| 28 | IP55 Earth Box, D2. | **15** |  |  |  |
| 29 | Main Panel Box, Plastic, 60 Slots, with DIN Rails, with Buss bars, with panel, IP65 | **8** |  |  |  |
| 30 | **Cable Glands, sizes** |  |  |  |  |
| A | 1/2" | **120** |  |  |  |
| B | 3/4" | **120** |  |  |  |
| C | 1" | **120** |  |  |  |
| D | 1.25" | **30** |  |  |  |
| 31 | PVC Trunk 12\*6 (Meters) | **60** |  |  |  |
| 32 | PVC Trunk 6\*4 (Meters) | **60** |  |  |  |
| 33 | Earth Buss bar, 4cm wide, with screws. | **15** |  |  |  |
| 34 | DIN Buss Bar, 2P, 11 screws | **8** |  |  |  |
| 35 | DIN Buss Bar, 5P, 11 screws | **8** |  |  |  |
|  | **Cables** |  |  |  |  |
| 36 | **Solar Cable, PV1-F, (meters)** |  |  |  |  |
| A | 6mm Black | **2500** |  |  |  |
| B | 6mm Red | **2500** |  |  |  |
| C | 25mm Black | **120** |  |  |  |
| D | 25mm Red | **120** |  |  |  |
| 37 | **XLP Cables, double Insulation, Copper, (meters)** |  |  |  |  |
| A | 3x6 | **200** |  |  |  |
| B | 5x6 | **120** |  |  |  |
| 38 | **Earth Cables, single, multicore, Yellow/Green, copper,(meters)** |  |  |  |  |
| A | 10mm | **300** |  |  |  |
| B | 16mm | **200** |  |  |  |
| 39 | **Flexible Cables, single insulation Copper, (meters)** |  |  |  |  |
| A | 6mm brown | **250** |  |  |  |
| B | 6mm Blue | **250** |  |  |  |
| C | 6mm Green/Yellow | **300** |  |  |  |
| D | 10mm Green/Yellow | **300** |  |  |  |
| E | Ethernet cable Cat6, double jacket outdoor | **900** |  |  |  |
|  | **Tools** |  |  |  |  |
|  | **PC Computer** |  |  |  |  |
| 40 | i7, 8th Generation, desktop, HD, 512Gb SSD. 21" Screen, Ram 16GB, GTX1070 Graphic card, Intel motherboard, All equipment from the same Band. Wireless mouse and keyboard. | **7** |  |  |  |
| 41 | Bosh/Makitta; Kit (angle grinder cut/rotary Hammer /hammer drill driver kit) with two 6Ah/18V Batteries | **4** |  |  |  |
| 42 | MC4 Crimping Tool, to crimp 4 & 6 mm cables | **3** |  |  |  |
| 43 | Clamp meter, 1000VDC, 600A(DC/AC) | **6** |  |  |  |
| 44 | Earth Loop tester | **3** |  |  |  |
| 45 | crimping pliers for Insulated terminals (1.5-6mm) | **9** |  |  |  |
| 46 | crimping tool for cable lugs (6-50mm) | **3** |  |  |  |
| 47 | **Metallic Box or specialized Bag, for tools accessories, to contain** | **2** |  |  |  |
| 48 | Deep socket 1/2" DR sizes (set) (8/9/10/11/12/13/14/15/16/17/18/19/20) | **2** |  |  |  |
| 49 | star key wrench folding set (TH9-10-15-20-25-27-30-40) | **2** |  |  |  |
| 50 | Hex key wrench folding set 7pc (2.5/3/4/5/6/8/10mm) | **3** |  |  |  |
| 51 | Holley star key wrench folding set | **2** |  |  |  |
| 52 | Gear Ring-Open end wrench sizes (9/10/11/12/13/14/15) (Set) | **2** |  |  |  |
| 53 | Set of CRV adapters 1/2" / 1/4 " / 3/8" | **3** |  |  |  |
| 54 | Step drill 4mm-32mm with impact ready | **3** |  |  |  |
| 55 | step drill 4mm-32mm with drill ready | **3** |  |  |  |
| 56 | Adapter for Rotary hammer to hold Masonry Bits | **5** |  |  |  |
| 57 | sockets ready to be installed on hammer drill driver kit, with magnet sizes (3/8" / 13mm / 15mm) (3 units total) | **5** |  |  |  |
| 58 | Magnetic power screw driving bits and Bit Holder, to hold screw driver heads (Slotted and Philips), in hammer drill driver) (2units total) | **3** |  |  |  |
| 59 | drill bits Masonry (7mm & 8mm) short length about 110cm | **3** |  |  |  |
| 60 | drill bits Masonry (12mm & 13mm) medium length about 210cm | **3** |  |  |  |
| 61 | drill bits Masonry (25mm) long length about 410cm | **3** |  |  |  |
| 62 | drill bit Metal (6-9-10-12-14)mm (5 units Total) | **3** |  |  |  |
| 63 | Grinding wheels 4.5" and 9" (Metal) | **3** |  |  |  |
| 64 | **Metallic Box or specialized Bag, for hand tools, to contain** | **3** |  |  |  |
| 65 | Industrial cable cutter | **3** |  |  |  |
| 66 | Insulated combination pliers 160mm | **3** |  |  |  |
| 67 | straight jaws locking pliers | **3** |  |  |  |
| 68 | diagonal cutting nippers 160mm | **3** |  |  |  |
| 69 | Berlin pattern snips | **3** |  |  |  |
| 70 | claw hammer fiber glass handle | **3** |  |  |  |
| 71 | engineers hammer glass handle | **3** |  |  |  |
| 72 | retractable utility knife | **3** |  |  |  |
| 73 | slotted screw driver set 10 pieces | **3** |  |  |  |
| 74 | Philips screw driver set 10 pieces | **3** |  |  |  |
| 75 | Voltage test Driver | **3** |  |  |  |
| 76 | Measuring Tape 25mm; 10m | **3** |  |  |  |
| 77 | Measuring Tape 25mm; 5m | **3** |  |  |  |
| 78 | **20-compartment organizer with removable dividers is optimal for hand tools and small parts. It features a  durable polycarbonate lid, carry handle.** | **3** |  |  |  |
| 79 | **Cable ends, wire terminals** |  |  |  |  |
| A | 2.5 mm | **300** |  |  |  |
| B | 6 mm | **900** |  |  |  |
| C | 10 mm | **600** |  |  |  |
| D | 25 mm | **300** |  |  |  |
| 80 | **Cable shoes** |  |  |  |  |
| A | 6 mm | **600** |  |  |  |
| B | 10 mm | **600** |  |  |  |
| C | 16 mm | **600** |  |  |  |
| D | 25 mm | **150** |  |  |  |
| 81 | **bag circle cable clips** |  |  |  |  |
| A | 6 mm | **300** |  |  |  |
| B | 10 mm | **300** |  |  |  |
| C | 12 mm | **300** |  |  |  |
| D | 14 mm | **300** |  |  |  |
| E | 16 mm | **300** |  |  |  |
| 82 | RJ 45 connectors | **300** |  |  |  |
| 83 | **Metallic Box, to contain** | **2** |  |  |  |
| 84 | self tapping screw flat head 5cm/5mm | **2000** |  |  |  |
| 85 | self tapping screw flat head 1.5cm/300 | **2000** |  |  |  |
| 86 | Palstim Anchors 7mm | **2500** |  |  |  |
| 87 | self drilling screw flat head (small) 13mm | **2000** |  |  |  |
| 88 | self drilling screws with hex head washer 14\*1" | **2000** |  |  |  |
| 89 | sleeve anchor bolts with hex bolt 3/8"\*1/2"\*65mm | **400** |  |  |  |
| 90 | **8mm (5/16) Heax Head, 6cm,** |  |  |  |  |
| A | screws | **1000** |  |  |  |
| B | Nut | **1000** |  |  |  |
| C | Washer | **2000** |  |  |  |
|  | **other** |  |  |  |  |
| 91 | PVC insulating Tape (10 different colors) | **300** |  |  |  |
| 92 | Plastic cable ties 30cm packet | **25** |  |  |  |
|  |  |  |  |  |  |
| 93 | Delivery to Nablus | **1** |  |  |  |
| 94 | Delivery to Jenin | **1** |  |  |  |
| 95 | Delivery to Deir Debuan | **1** |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| **1 Item Number** | **2 Specifications Required** | **Total** | **3 Specifications Offered** | **4 Notes, remarks, ref to documentation** | **5 Evaluation Committee’s notes** |
| **LOT 2: 5kWp Grid-tied Solar System - Tulkarem Industrial School** | |  |  |  |  |
| **2.1** | Polycrystalline or Mono-crystalline Modules | 16 |  |  |  |
| **Photovoltaic Modules** | Minimum rated power 320 W per module |
|  | Positive Power Output Tolerance |
|  | Minimum module efficiency @ STC ≥ 15.6% |
|  | Anti-reflective Glass with Self-Cleaning Layer |
|  | Aluminum Frame |
|  | Maximum Ratings; Operational Temperature -40 ~ +85 °C; Maximum System Voltage 1000 VDC; Max Series Fuse rating 15 A |
|  | IP65 junction box or higher. |
|  | PV cells should be of grade A |
|  | Have factory – premounted DC solar connectors MC4 or H4 type. |
|  | PV panel manufacturer is certified according to ISO 9001 and ISO 14001. |
|  | At least 10-year product warranty against defects from design, material or workmanship. |
|  | At least 25-year linear power warranty for min. 82% power output after 25 years, 90% after 10 years |
|  | IEC 61215, IEC 61730, IEC 61701 & IEC 62716 Certifications |
|  | Anti-Potential Induced Degradation (PID) according to IEC 62804 |
|  | Exposed to a Flash Test (Test results will be required) |
|  | Module manufacturer should be one of the top 10 manufacturers in the Tier 1 ranking |
|  | Through installation, minimum space between photovoltaic modules from all sides is 0.5 cm. |
| **2.2** | Grid-tied 1-phase inverters | 1 |  |  |  |
| **Multiple Grid-Connected Inverters** | 1 unit of 5kWn , (String Inverter) |
|  | Minimum 2 MPPT Inputs per inverter |
|  | AC Output Single-phase, Rated Voltage 230V |
|  | Rated Frequency 50 Hz ± 5 Hz |
|  | Outdoor Inverters (IP65) with LCD Display |
|  | Ground Fault Indicator |
|  | Peak Efficiency > 98%, European Efficiency > 98% |
|  | Noise Emission < 50 dB @ 1m |
|  | THD < 3%. The voltage should be calibrated -15%, +10%. |
|  | Provided with integrated DC load –break disconnect. |
|  | Compatible with industry –standard monitoring and GSM data communication systems (e.g. Meteocontrol, Fat Spaniel) or similar system provided by the inverter manufacturer. |
|  | At least 10-year product warranty |
|  | Certifications; TUV, CE, VDE 0126-1-1, VDE AR-N-4105, AS 4777-2, AS 4777-3, AS 3100, IEC 61727, EN61000-6-1, EN61000-6-3 and EN 50178. |
|  | The inverter should be communicative via Bluetooth or RS485 |
|  | The inverters must be protected from direct sunlight and from direct impact of rainfall |
|  | The inverter should be approved in accordance with the following certificates; VDE AR-N-4105, AS 4777-2, AS 4777-3, AS 3100, IEC 61727 and EN61000-6 |
|  | - The inverter must be made in Europe |
|  | - The Inverter Manufacturer must have an Authorized Technical Service center in Palestine or Israel since more than 5 years. |
|  |  |
| **2.3** | Web Based Monitoring system, data logger or imbedded in Inverter. | 1 |  |  |  |
| **Monitoring System and Weather Station** | Ethernet port for communication |
| To monitor the inverter and its main parameters. |
|  |
| **2.4** | According to Tulkarem Municipality requirements, including 3 phase bidirectional energy meter for the whole school, Indirect with current transformers, and single-phase Energy meter for the production meter. and all required boxes and protections. unless otherwise stated by the Municipality. | 1 |  |  |  |
| **Digital kWh Meter-Production Meter** |
| **2.5** | Galvanized steel Mounting structure, or Aluminum. | L.S. |  |  |  |
| **Mounting Structure** | To withstand not less than 120km/h wind speed, according to a certified Structural Civil engineer department. |
|  | No perforating on the roof, the use of prefabricated concrete blocks Not less than 16 units, of weight 70-90kg |
|  | Tilt angle of the mounting structure must be between 25-30 degrees |
|  | All Structures must start at an elevation of more than 50cm above the concrete base level. |
|  | The structure must be treated to remedy any harm or damage to the galvanizing coating |
|  |  |
| **2.6** | Solar PV1-F Type | L.S |  |  |  |
| **DC Cable** | 6mm² thickness, two different colors |
| **2.7** | XLP Cable 3x10mm² | L.S |  |  |  |
| **AC Cable** | Double insulation, UV resistant, Temperature range: -15 ~ +90 °C |
|  | Flame retardant according to IEC 60332-1 |
|  | IEC, TUV, UL, VDE, or KEMA certification |
| **2.8** | All cables from PV strings to inverters, and from inverter to electrical panel and from electric panel to energy meters must be inserted in cable protecting UV resistant conduits | L.S |  |  |  |
| **Cable Protection** | Since a probability of severing or damage in cables appears, cables or strengthened conduits will be used |
|  | Electric cords will respect the code standardized by colors (in direct current the blue thread will be the negative polarity; in alternating current phase: red / brown / black, neutral: blue, PE: green-yellow). |
|  | To limit the surges due to the lightning, the conductors of positive and negative polarity of the photovoltaic modules have to be contiguous mounted with the equipotential connection. We shall watch that the cables of connection between the photovoltaic field and the electric equipments are stuck on all their length to the cable of mass. |
|  | A complementary, typical protection sheath or gutter allows to increase the degree of protection. |
|  | The pathway of electric cables as well as their fixation and that of the other elements as for example the boxes of junction will be realized so as to become integrated, at best, in the concerned buildings, while trying to reduce the lengths. |
|  | Cables must be correctly fixed, in particular those were exposed to the wind.Cables have to walk in zones beforehand defined or inside mechanical protections. They must be also protected from angular edges. |
|  | All DC and AC Cables running inside the cable trays and trunks must be inserted into corrugated (with metal) industrial PVC flexible pipes. |
|  | All DC and AC Cables running indoors must be placed inside appropriate Plastic Trunks. |
| **2.9** | Suitable for outdoor use (IP65) | 1 |  |  |  |
| **DC Panel and Protection** | DC Junction Box |
|  | 24 slots at least. |
|  | Including DC Breakers and DC Surge arresters (surge protection device) Type II |
|  | All required cable glands and buss bars included |
|  | Box with panel. |
|  | Accessible to the breakers without opening the whole cover. |
| **2.1O** | Suitable for outdoor use (IP65) | 1 |  |  |  |
| **AC Panels and Protection** | AC line must be double-protected (i.e. inverter-side AC protection and on the side of M.D.B) |
|  | Appropriately sized 2-pole AC circuit breakers according to international standards, Short circuit current protection |
|  | General circuit breaker of limit of concession (subscriber's circuit breaker) correctly sized : Appropriately sized Earth Leakage with sensitivity of 30 mA and Overvoltage protection according to IEC requirements |
|  | Protection equipment must have IEC and TUV certifications |
|  | AC Surge protection 2 Pole. |
|  | Includes any required extra breakers at the existing main Electrical Board |
| **2.11 Grounding System** | The earthing system should be done according to IEC requirements and according to internationally accepted standards. | L.S |  |  |  |
| Interconnection of all the metallic masses of equipments of the installation of production and electricity supply by using green/yellow protection conductors. |
| The earthing system should not be connected to the Grid earthing or Surge protection system |
| The system resistance should be between (2-5) ohms from any location. unless otherwise stated by the municipality. |
| Each PV module shall be grounded (to steel structure) using 10 mm2 cross section cables minimum |
| Steel structure & Inverter shall be grounded (to main earthing box) using at least 16 mm2 isolated copper wires cross section cables |
| All metal components including cable trays must be grounded using 16 mm2 isolated copper wirescross section cables |
| Main earthing cable used to connect the main earthing busbar and the earthing electrodes must be of 16 mm2 isolated copper wires |
| Contractor must ensure continuity of the earthing system |
| One point (bus bar) for the whole system earthing is required. Earthing of the PV system (including all its parts) and earthing for the lightning protection system must be the same as the existing earthing system of the building |
| All Earthing regulations and requirements set by Tulkarem Municipality must be followed. |
| If Electrodes are to be used only Taken Electrodes will be accepted, (copper crest), and every electrode must be inserted into an appropriate Concrete manhole. |
|  |
| **2.12 System Installation & Operation** | Complete system installation, commissioning, and testing appropriately and according to the existing local electricity requirements and grid code | L.S |  |  |  |
| The inverters should be easily accessible and protected from direct sunlight and from direct impact of rainfall |
| All parts of the solar system (Modules, inverter, protection panels – DC & AC, cables…) must bear warning signs and labels according to local standards and requirements. |
| The installation must follow the requirements of Tulkarem Municipality. |
| Maintenance assistance for a first base instructions is free two years after the implementation. |
| Warranty and Maintenance assistance for a first base instructions is free two year after the implementation |
| **2.13 Grid Connection** | Complete supply, installation and commissioning of a Bidirectional kWh meter panel | L.S |  |  |  |
| Suitable for outdoor use (IP65) |
| The Bidirectional meter panel shall be installed at the connection point (Grid-side) |
| Each panel should include the kWh meter, appropriately sized 2-pole or 4-pole AC circuit breaker (main AC MCB), and any other material required to ensure that the panels are installed according to local standards and requirements (the installation must follow the requirements of Tulkarem Municipality |
| **2.14 Warning Signs** | The electric warning signs should be installed on each component of the PV system (inverters, connection and distribution boards, mounting structure, modules …etc.) | L.S |  |  |  |