

## TECHNICAL SPECIFICATIONS

Data contained in this document are considered as being complete enough for preparation of proposal. All additional information needed, the Bidder shall collect during the site visit, after selection.

### 1. Codes and Standards

Material or equipment supplied according to this Invitation to Tender shall comply with the latest edition of the applicable references listed as follows:

- IEC 61000-4-2 Electromagnetic Compatibility (EMC),
- IEC 61000-4-3 Electromagnetic Compatibility (EMC),
- IEC 61000-4-4 Electromagnetic Compatibility (EMC),
- IEC 60904-1 to IEC 60904-10 Photovoltaic devices,
- IEC 61427 Secondary cells and batteries for photovoltaic energy systems (PVES) - General requirements and methods of test
- IEC/TS 62257-1 to IEC/TS 62257-7 Recommendations for small renewable energy and hybrid systems for rural electrification
- HRN Catalog of Croatian standards.

It shall be Bidder's responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes and Standards, as well as the Codes and Standards of the country of Croatia.

All the delivered equipment must be labeled with "CE" conformity marks, also for every piece of equipment, declaration of conformity shall be included. Main equipment (listed under "2. System Description") documents shall also be written in Croatian language.

### 1.2. System Description

The proposed system shall be hybrid system, accommodating PV and wind generator sub-systems. Major equipment/devices are listed as follows:

1. PV modules,
2. Junction boxes (including fuses, diodes, etc.),
3. DC main switch,
4. Lightning protection/earthing/grounding/surge protection devices,
5. Charge controller,
6. Batteries,
7. Inverter,
8. AC switch disconnect switches,
9. Connections, DC and AC power cables/wiring,
10. Electrical cabinet,
11. Measuring instruments, local indication panel and web-based monitoring system,
12. Wind turbine generator.

The system shall be designed, delivered and installed in such a way to safely supply electrical energy (at least

partially) to typical loads at “Solar Academy” center. These loads are: 3 refrigerators, 1 deep freezer, water pump, lighting, 1 dish washer machine, several laptop charging and small tools (such as drilling machine) utilizations. The estimated available roof area is 86,6 m<sup>2</sup> (one half of 10 m X 15 m sloped at 30°), which is obviously too small to accommodate enough PV panels to supply enough energy for all the loads. So, energy from the batteries shall be consumed only when “low power” load is applied. So, there shall be at least two modes of operation: load is powered from the batteries (through inverter) and load is powered from the power grid (disconnected from inverter, but battery charging circuit is active). This is why two AC disconnect switches are needed: the first one that shall connect the load to inverter (at the same time the other AC disconnect switch is disconnected) and the second one that shall connect the load to power grid (at the same time the other AC disconnect switch is disconnected). System must be implemented in such a way to ensure that at least one of the AC disconnect switches is disconnected (“open”) at any time instant. That would typically happen during the summertime when the center is populated and energy consumption is high.

There is an additional request on inverter: it shall be of “grid connected” type. The reason for that is Investor’s intention to adapt the proposed system and fully establish “on grid” hybrid system. That shall happen in near future (couple of years) and some other minor changes shall be required. The Bidder shall design proposed system in such a way to minimize these system changes.

### **1.3. Equipment Requirements**

Major equipment/devices requirements are listed as follows:

#### **1.4. PV modules**

PV modules shall be manufactured from mono-crystalline cell type. Module output shall be suitable to charge 24 VDC batteries. Modules shall be certified according to IEC61215 or IEC61646. “TUF-PROOF” marked modules are preferred. PV modules shall be purchased with all the installation and interconnection material included. The Bidder shall declare a guarantee period for 90% of the nominal power rating. The Bidders shall install minimum of 1,0 kW nominal power of PV modules, preferably 1,5 kW or more, and easily expandable up to cca 4 kW in the future.

#### **1.5. DC main switch**

In the event of faults or in the order to carry out maintenance and repair work, it must be possible to isolate the inverter from the PV and wind turbine generators. DC main switch is used for that role. According to the IEC 60364-7-712 standard, an accessible load switch is required between the PV generator and inverter. The DC switch shall be installed directly before the inverter (it shall not be integral part of inverter). It shall be rated for the maximum open-circuit voltage of the generators (at -10 °C) and for the maximum generators’ current (short-circuit current under STC). The Bidder shall quote it based on its own calculations/estimates taking into account all the future system enlargements.

#### **1.6. Lightning protection/earthing/grounding/surge protection devices**

Generally, the following applies: PV systems do not increase the risk of buildings being struck by lightning. Therefore, there is no need for an additional lightning protection system. However, there shall be also wind turbine sub-system installed that shall include exposed metal tower/console. It is the Bidder responsibility to properly design/deliver/install quoted protection devices accord to actual Croatian standards (considering lightning and overvoltage protection classes and all other applicable requirements).

### **1.7. Charge controller**

The standard charge controller tasks are as follows: optimum charge to the batteries, overcharge protection, preventing unwanted discharging, deep discharge protection and providing information on the state of the charge of the batteries. There are two more tasks for the charge controller of this system, these are: besides PV sub-system, controller shall accommodate wind turbine sub-system and during the wintertime season controller shall supply energy to battery heater (supplied by Contractor) and panic lights. In order to get the most possible power from the PV array, a maximum power point tracker technique (MPPT) shall be used. The Bidder shall quote it based on its own calculations/estimates taking into account all the future system enlargements.

### **1.8. Batteries**

Sealed (lead-acid gel), maintenance free, 24 VDC battery bank shall be quoted. Estimated minimum “Ahs” are 500 Ah. The Bidder shall make his own calculation taking into account all the future system enlargements. The quotation shall be based on the higher “Ah” value. Batteries shall be certified according to IEC 896-2.

### **1.9. Inverter**

Three-phase inverter shall be of “grid connected” type. Input voltage of 24 VDC, output voltage of 230 VAC, 50 Hz. Inverter shall be designed oversized, taking into account the power of total number and type of all the PV modules and wind turbine generators installed at the site. Estimated power is 5 kW, but the Bidder shall make his own calculation taking into account all the future system enlargements. The quotation shall be based on the higher power value. Inverter shall be certified according to IEC 61727, IEC 62116 and IEC 60364.

### **1.10. AC disconnect switches**

The AC disconnect switches must be double-pole, clearly labeled and lockable in the “OFF” position only. The Bidder shall quote them based on its own calculations/estimates taking into account all the future system enlargements. They shall be quoted/designed based on standard manufacturer practice.

### **1.11. Connections, DC and AC power cables/wiring**

Preferable connection type is with screw terminals, but all other types (especially plug connectors) shall be considered if they have transfer resistance of less than 5 miliohms. PVC-sheathed cable (with NYM or NYY codes) can be used for main DC cable, but they need to be UV protected. Cable type “NHMH-J” shall be preferred due to the environmental reasons. Individual screened cables for positive and negative branches are recommended. For AC connection cable, a five-pole cable shall be used; usual protected cables of type NYM, NYY or NYCWY can be used. All the cables shall be laid in corresponding cable trays. The Bidder shall quote them based on its own calculations/estimates taking into account all the future system enlargements. They shall be quoted/designed based on standard manufacturer practice.

### **1.12. Electrical cabinet**

It shall be lockable and used to accommodate AC disconnect switches, earth leakage circuit breakers and other required protection equipment. It shall be quoted/designed based on standard manufacturer practice.

Also, the Bidder shall quote it based on its own calculations/estimates taking into account all the future system enlargements.

### **1.13. Measuring instruments, local indication panel and web-based monitoring system**

Voltage, current, power and energy meters shall be supplied for PV and wind turbine sub-systems. All the measurement values shall be locally (local LCD panel on the site) and remotely (web-based ) displayed for both sub-systems separately and totalized. Web-based data monitoring system shall also include hybrid system statuses (such as alarms, security and malfunction warnings) and establish data transmission to “Friends of the Earth – Croatia” office in Zagreb. Draft data communication standard IEC62350 shall be used. It shall be powered by UPS.

### **1.14. Wind turbine generator**

A small wind turbine generator rated to produce cca 600 watts (at 24 VDC) shall be installed. The wind turbine shall be equipped with its own electronic controller, installation tower and auxiliary material. Strongly preferred model is „Ampair 600-24“ with AO6 MOO wall mount kit produced by Ampair ([www.ampair.com](http://www.ampair.com))

### **1.15. General Requirements**

It is the responsibility of the Bidder to examine the specifications and requirements in this document. Any errors or omissions shall not be the reason for relieving the Bidder from proposing a working solution. Even though this is “turn key” type of project, Investor is entitled to approve all the equipment prior to corresponding ordering procedure. The Contractor shall deliver equipment whose minimum quality is mutually agreed and defined by the Contract.

Bidder may, in addition to the base bid, submit alternate proposals for the equipment or systems that they think shall fulfill the specified requirements more efficiently or more economically than those set forth in the specification. However, any and all alternate proposals shall be clearly identified, with all supporting technical documentation. The alternates shall be referenced to the specific section of the specification that is applicable. Undocumented alternates are subject to rejection.

All the outdoor metal structures will be exposed to harsh weather, so they must be made of resistive materials such as stainless steel. Also, all the outdoor equipment/structures must be adapted to high winds (wind zone #3). Special attention shall be given to roof static/dynamic loads and battery bank placement/installation (considering its weight).

The required documentation in Croatian language from the Bidder is as follows:

- a) Calculations of yearly system production for both sub-systems (having in mind site conditions such as shading and surrounding objects), PV sub-system production shall be calculated according to “Solar Radiation Handbook of Croatia” issued by Energy Institute “Hrvoje Požar”, wind turbine sub-system production shall be calculated according to “Mean Annual Wind Speed Map of Croatia” issued by “Meteorological and Hydrological Service of Croatia”, for this location it is about 4 m/s (10 m above ground level) – **delivered with the proposal by all Bidders;**
- b) “for construction” documentation– shall be delivered by rewarded Contractor only; subject to Investor’s approval;
- c) “as built” documentation – shall be delivered by rewarded Contractor only; subject to Investor’s approval;
- d) operating and maintenance manual – shall be delivered by rewarded Contractor only; subject to Investor’s approval.

