Annex 2

Ground-mounted and rooftop photovoltaic (PV) solar power plants with a capacity of up to 150 kW (PV-150 projects)

Minimum technical requirements

The technical requirements and recommendations for the installation of PV systems up to 150 kW installed on land and on the roof shall be verified based on the below mentioned: ***Checklist of Submitted Documents (hereinafter referred to as the Checklist)***, which shall be completed by the specialist of the Partner Financial Institution and the Renewable Energy and Energy Efficiency Fund of Armenia (R2E2), a subcontractor of Fichtner GmbH & Co KG. The results of the technical assessment shall be summarized in the last column of the Checklist, as well as in a summary report, which shall include the following:

- Brief description of the project (location, installed capacity, financing amount, photos of the project area, name of the ESCO company and module manufacturer)
- Checklist analysis
- Site visit summary
- Conclusion and recommendations

The technical evaluation must be carried out in accordance with the requirements below.

General requirements:

- The capacity of the solar PV plant shall not exceed the consumption needs of the beneficiary.
- Maintaining environmental, health and safety during construction and operation, and ensuring safe working conditions in accordance with national norms and standards when working with electrical systems. Particularly, the availability of safety equipment, rubber gloves, an electric shock chart for implementing first aid measures in case of electric shock, a first aid kit, fire extinguishers, sand buckets, a transformer, battery and hazardous waste management system. All the staff must be trained in first aid and firefighting.
- Availability of a complaint mechanism by other parties during construction.
- Ensuring grid connection and electricity transmission.
- The ratio of the total power of the modules to the total power of the inverters in each subsystem shall not exceed the factor of 1.2.

- Structural design justification for foundations and module mounting structures, especially considering wind and snow loads in accordance with site standards. Submitted if necessary (upon request of the Foundation specialist).

- Comprehensive and complete grounding justification, if requested by the specialist. Submitted if necessary (at the request of the Foundation specialist).
- Adequate corrosion protection against all installed systems.
- Proper sealing of all junction boxes, insulation of cable connections (glands).
- Proper labeling of modular rows, junction boxes, and cables.
- Conducting system and component operational tests (factory acceptance testing, on-site acceptance testing).
- The engineering, procurement and construction of the system must be carried out by a certified company (ISO 9001, ISO 14001 and OHSAS 18001 or a national license to operate).
- Use only cables and cable ducts that are resistant to ultraviolet radiation, as well as sufficient protection of all cables installed outdoors from pests, adequate reinforcement of cables, ensuring the permissible bending radius of all cables, and closing of cable ducts.
- An Operation and Maintenance (O&M) contract, which should require an operation and maintenance plan, work regulations for professional staff, a quality manual, personnel qualification requirements and define guarantees designed to meet key performance indicators such as: availability, regular preventive maintenance and response time constraints. O&M planning should be based on IEC 62446. Where modules are cleaned regularly, the impact and required frequency of module cleaning should be assessed at least once a year.

Modules

- Solar modules must have a minimum 25-year linear performance warranty. Standard crystalline or thin-film modules must be installed. Modules must be certified for snow pressure of 5400 Pa.
- PV modules must have validated certificates, which must be issued by a reputable testing organization in accordance with IEC/EN standards.
    - Design qualification and type approval in accordance with the requirements of IEC/EN 61215.
    - Potential Induced Degradation (PID) test in accordance with IEC TS 62804-1 standard.

- Availability of testing and certification for compliance with the IEC 61730 electrical safety standard.
- PV modules must have a minimum efficiency of 22% under standard test conditions.
- Module degradation guarantee should be below 20% over 25 years and below 10% over the first 10 years. All modules should have only positive tolerance (0%/+5%).
- All PV modules must be of the same type and from the same manufacturer.

Inverters

- Standard inverters should be installed. Inverter types must comply with IEC standards (e.g. IEC 62109-1/2) and national regulations. Particularly, local standards and requirements of the grid operator for grid connection (e.g. grid code) must be observed.
- Inverters must have a minimum European efficiency of 97%. All inverters must be of the same type and from the same manufacturer.

Certificate of Conformity for PV DC Cable

DC cables used in solar PV plants must have certified certifications that comply with IEC standards (e.g. EN50618/TUV 2pfg 1169/09/07 or IEC62930) and national regulations.

Solar PV station mounting structures

- Load-bearing structures shall be made of construction-grade aluminum alloy, stainless or galvanized steel, or steel with an equivalent corrosion protection system (such as Magnelis®) and with a minimum 25-year warranty in appropriate climatic conditions (RA Construction Standard II-7.01-2011). The mounting structures used must be products recognized in the market, designed for PV solar plants, and with good reputation.
- The design of the module placement and mounting structure shall take into account the higher wind load on the roof slopes and corners and ensure an appropriate height (distance). In any case, PV modules shall not be located hanging from the roof slope and peak.
- When parallel installation of modules on the roof of a site, access routes for maintenance and cleaning of the modules must be considered, in accordance with the operation and maintenance plan.

- Load-bearing structures must comply with the requirements of international and local standards.

Installation and launch

- For safe installation of the system, compliance with the requirements of IEC 60364 must be maintained. For DC installations, the requirement of IEC 60364-7-712 shall particularly be taken into account.
- The requirements of IEC 62446 apply to commissioning and testing. The results of commissioning and safety testing must be documented and maintained accordng to the standards.

Guarantees

- There must be a minimum 5-year warranty for all components, as well as the entire system, including replacement and repair.
- Minimum 5-year warranty for inverters.
- A minimum 10-year warranty for PV modules, as well as a linear productivity (performance) warranty guaranteeing a minimum of 80% productivity in 25 years.

FASTBANK

Checklist of submitted documents

Name of the PV plant (borrower)._____

N	Document name	Received	Comments	Verified	Comments / Notes
1	Location coordinates	□		□	
2	Land ownership certificate or lease agreement with permission from the land owner to implement the project *or* Rooftop installation permit (from the roof/building owner)	□		□	
3	1. Energy production forecasting / simulation with PVsyst or equivalent commercial software. 2. Volume of own consumption by month, based on existing demand data (electricity bills) and/or reasonable assumptions for new structures/enterprises	□		□	
4	Project description with floor plan, engineering infrastructure, electrical and mechanical equipment	□		□	
5	Justification of the structural design of the appropriate structures for the installation of the foundations / roof and the fastening (mounting) of the modules to withstand wind and snow loads in the relevant area / roof. Justification of the design may be required at the request of the Foundation Specialist.	□		□	
6	Electrical single line diagram for direct current (DC single line diagram), protection, switches, cable specifications	□		□	
7	Technical data for connection to the network, (AC single line diagram), protection, circuit breakers, cable specifications	□		□	
8	Technical specifications of PV modules, including: PV module conformity certificates	□		□	

9	Inverter specifications, including inverter certificates of conformity	☐		☐	
10	PV DC cable conformity certificate	☐		☐	
11	From the distribution network operator or the entity granting permission to connect to the network	☐		☐	
12	Cost estimate	☐		☐	
13	Implementation schedule	☐		☐	
14	Photos of the site and other structures	☐		☐	
15	Conclusion on the technical condition and load-bearing capacity of the roof	☐		☐	