



**1 MWp PV Plant
O&M PLAN
TEPCO
Technical Projects Company S.A.E.**

Version	Date	Constructed	Approved
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OPERATIONS AND MAINTENANCE PLAN: 1 MWp PV Plant

General

GreenEnergy Finland Ltd is a Finnish based company that develops comprehensive solutions based on solar and wind energy applications. Our aim is to satisfy our clients' needs by delivering solutions for the reliable and cost-effective production of energy.

GreenEnergy Finland Ltd is a member of the Finnish association of electrical equipment manufacturers, SELT Ry. and the Finnish Solar Energy Association as well as member of Cleantech Finland. In addition, we work in close collaboration with many global partners, such as ABB, JA Solar etc.

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General Description of 1034,9 kWp PV plant O&M Plan

This O&M Plan contains the required maintenance and inspection tasks for 1034,9 kWp photovoltaic (PV) plant delivered and installed to 6th of October City, Egypt, to ensure the operational status of the plant in all conditions.

The O&M Plans consist of three main sections

- Scheduled maintenance
- Unscheduled maintenance
- Performance monitoring and control

The required personnel and tools to carry out the Operations and Maintenance Plan are also summarized.

1. Scheduled maintenance

The operation of the PV plant is constantly monitored by GEF Vision software. Scheduled maintenance is generally carried out at regular intervals with the aid of feedback from GEF Vision, and the case of power electronics components (i.e. inverters and transformers), in accordance with the manufacturer's recommendations, and as required by equipment warranties.

MODULE CLEANING

Module cleaning is the single most important maintenance task of the plant. If the system efficiency is found to be below the expected level, then the cleanliness of the modules should be checked and cleaning conducted as necessary. Module cleaning is conducted by hand, with a suitable dust broom. Cleaning must be conducted with caution, to prevent any damage to the PV modules. Scheduled module cleaning is performed at night, to avoid interference at plant operation.

CONNECTION INTEGRITY

Cable connections between PV modules within each module string are checked annually. Loose connections are tightened.

MECHANICAL INTEGRITY

The PV plant mounting system is visually inspected annually, for erosion or loosening of bolts, screws and other mechanical fixings. Loose connections are tightened, eroded components are replaced if found necessary.

THERMAL IMAGING

Potential faults across the PV plant can often be detected through thermography. Large variation in temperature can cause loose connections in junction boxes, PV modules and inverters. It is recommended to conduct thermography using a thermographic camera annually.

ELECTRONIC CABINETS

All DC array boxes and distribution cabinets are checked annually for water ingress, dirt or dust accumulation and integrity of the connections within the boxes

INVERTER SERVICING

The inverters of the PV plant are checked periodically according to a separate maintenance program provided by the manufacturer.

2. Unscheduled maintenance

The plant maintenance operator should be equipped to handle small-scale failures with a response time of one working day. These include repairing blown fuses, replacing damaged PV modules, tightening loose connection and such small tasks.

SPARE PARTS

The plant operator should have the following spare parts continuously on site:

TYPE	AMOUNT	Estimated cost
PV Module	40 pcs	5000€
Solar cable connector (PV-stick)	30 pcs	100€
Mechanical fixings	1 set	1000€
Inverter, Ingeteam	1 pcs	2500€
DC Array box, ABB	1 pcs	1500€
T1 Transformer	1 pcs	15000€

Unscheduled maintenance does not include major overhauls and improvements to the plant. These are conducted according to their own plan, and separately from the regular maintenance.

3. Performance monitoring

The plant is monitored via GEF Vision interface, and maintenance tasks are scheduled according to the feedback from GEF Vision. Also, the set-point values of the PV plant issued by the Grid Operator, are managed via the interface.

GEF Vision enables full remote control of the plant, and if agreed with the Grid Operator, and suitable connections between the Grid Operator and the PV plant are provided, the control of the set-point values, such as output power and power factor can be automated with response time as fast as 250ms. At plant start-up, the Grid Operator issues the set-point values by telephone to the maintenance operator personnel.



4. Personnel, facilities and tools

The minimum requirement for operation of the PV plant is two persons, equipped with a set of tools suited for the scheduled maintenance tasks. The O&M personnel are located either on-site, or nearby, to ensure the desired response time for unscheduled maintenance tasks. During scheduled module cleaning operation, a crew of 5 persons is required.