

Development of a Training Course on PV Systems Installation

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Abstract

The deployment of photovoltaics in large scale, in particular PV microgeneration, requires the development of a numerous workforce trained for PV systems installation and maintenance. Since there is an obvious lack of local training opportunities for PV professionals, the University of Lisbon and INETI have promoted a new Training Course for PV System Installation with special emphasis on hands-on practical experience and safety issues.

Keywords: PV systems, training, installation

1. Introduction

The full potential of photovoltaics, as microgeneration in residential urban context as well as in off-grid stand alone systems, can only be successfully achieved through the appropriate training of the PV installation professionals. In Portugal, where a recent law has defined the framework for the development of microgeneration, it is expected that this sector will witness a fast increase.

However, if these systems are improperly designed, incorrectly installed, not properly maintained or if the users are not instructed in the proper use and routine maintenance, they will fail to meet performance expectations, or they might fail altogether.

Since there is an obvious lack of local training opportunities for professionals in this field, we have developed a training course on PV Systems Installation. The non-availability of similar training courses, certified or non-certified, required that the proposed training course should fulfil two objectives: i) prepare the participants for the installation of PV systems; ii) set a quality standard for other training courses expected to be organized in the future.

For the moment, the PV System Installation Training Course is open to professional electricians (Level III) only. In the foreseeable future, however, and as a result of partnerships to be developed with professional schools, it is expected that the training course might be offered within a broader context as a Professional Course of PV Systems Installation.

This training course was developed in a partnership between University of Lisbon and the Renewable Energy Department of INETI and tries to combine a solid theoretical preparation with hands-on practical experience.

3. Course description

The PV System Installation Training Course is a one week course, taught in fulltime (35 hours) for a class of 12 trainees. The morning sessions are devoted to theory classes and concepts discussions, while the afternoon sessions focus on hands-on practical experience, including system sizing,

installation and measurement of PV modules, inverters, charge controllers, and complete PV systems. The last session of the course includes a written assessment for evaluation of the learnt skills.

The contents of the theory classes are listed in Table 1. Although it includes a general overview of solar radiation, PV fundamentals and a short module on system sizing, the special emphasis of the course is given to practical installation issues related to system configurations, components, wiring as well as safety precautions. The course bibliography includes general texts on PV installation [1, 2] as well as specific instructions regarding safety issues [3] and a guidebook especially developed for this course [4].

Table 1. Course contents.

Solar radiation	Annual radiation Solar Spectrum Diffused and direct radiation Position of the sun Orientation Inclination Solar trajectory maps (stereograph projection)
PV fundamentals	Photovoltaic solar cells Solar module IV characteristic Cell parameters Efficiency
Autonomous PV systems	System configuration System sizing Batteries Inverters Charge controllers
Grid connected PV systems	System configuration System components Configurations for inverter connection Choice of inverters Wiring Protection elements Grid connection
Safety	PV systems handling hazards Electric hazards Precautions Risks associated to batteries Other risks Safety recommendations

One of the defining characteristics of the PV System Installation Training Course is hands-on experience. The course thus includes a series of three afternoon lab classes where the trainees will

be involved in the tasks listed in Table 2, which also includes details on the equipment required for each task.

Table 2. Practical tutorials: topics, tasks and equipment

Topic	Tasks	Equipment
IV curve and module interconnection	Interconnection of modules in series and parallel Measurement IV curves for each configuration Discussion.	IV curve measurement device Multimeters General tools
PV systems measurements (hybrid and façade systems)	Measurement of: <ul style="list-style-type: none"> • Solar radiation • Environment and module temperature, • Battery charge current and voltage • Inverter output current. Comparison between systems Discussion.	Scope Multimeters Thermometers PV hybrid system PV façade system
PV system sizing • water pumping • solar home • telecom power • grid connected	System sizing Tests and measurements Discussion	Retscreen software Solterm 5 software Multimeters Electric wires Current shunts PV module

5. Conclusion

The contents and main features of a new Training Course for PV System Installation are presented. The course, targeting professional electricians, has a strong component of hands-on experience and includes a full discussion of safety issues. Its general aims are i) to prepare the participants for the installation of PV systems; and to ii) set a quality standard for other training courses expected to be organized in the future.

References

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