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TECHNICAL SPECIFICATION

Recommendations for renewable energy and hybrid systems for rural electrification – Part 4: System selection and design

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RECOMMENDATIONS FOR RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

Part 4: System selection and design

FOREWORD

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62257-4, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition issued in 2005. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

– redefine the maximum AC voltage from 500 V to 1 000 V, the maximum DC voltage from 750 V to 1 500 V;
– removal of the limitation of 100 kVA system size. Hence the removal of the word “small” in the title and related references in this technical specification.

This technical specification is to be used in conjunction with the IEC 62257 series.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
82/949/DTS	82/1000A/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62257 series, published under the general title *Recommendations for renewable energy and hybrid systems for rural electrification*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The IEC 62257 series intends to provide to different players involved in rural electrification projects (such as project implementers, project contractors, project supervisors, installers, etc.) documents for the setting up of renewable energy and hybrid systems with AC voltage below 1 000 V and DC voltage below 1 500 V.

These documents are recommendations:

- to choose the right system for the right place;
- to design the system;
- to operate and maintain the system.

These documents are focused only on rural electrification concentrating on but not specific to developing countries. They should not be considered as all inclusive to rural electrification. The documents try to promote the use of renewable energies in rural electrification; they do not deal with clean mechanisms developments at this time (CO_2 emission, carbon credit, etc.). Further developments in this field could be introduced in future steps.

This consistent set of documents is best considered as a whole with different parts corresponding to items for safety, sustainability of systems aiming at the lowest life cycle cost as possible. One of the main objectives is to provide the minimum sufficient requirements, relevant to the field of application that is: renewable energy and hybrid off-grid systems.

RECOMMENDATIONS FOR RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

Part 4: System selection and design

1 Scope

This part of IEC 62257 provides a method for describing the results to be achieved by the electrification system independently of the technical solutions that could be implemented.

The purpose of this part of IEC 62257 is to provide a method to assist project contractors and project developers to select and design the electrification system for isolated sites while matching the identified needs, such as those described in IEC TS 62257-2. IEC TS 62257-2 assesses the needs of the users and the different power system architectures which can be used for meeting these needs. In relation to the needs of the different participants to the project, functional requirements that shall be achieved by the production and distribution subsystems are listed.

In Clause 5, energy management rules to be considered are described. These are key issues as they have a great influence on the sizing of the electrification system.

In Clause 6, the informations provided by the system sizing process to allow the participants to select the equipment or component able to fulfil the functional requirements are listed.

To allow and facilitate the management of the micro-power plant and the maintenance of the whole electrification system, some information is collected and monitored.

Clause 7 is dedicated to defining the parameters and specifying rules for data acquisition.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 62257-2:2015, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 2: From requirements to a range of electrification systems*

IEC TS 62257-3:2015, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 3: Project development and management*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
renewable energy
RE
energy from a source that is not depleted when used

3.2
hybrid system
multi-sources system with at least two different kind of technologies

3.3
dispatchable power system
power system considered dispatchable if delivered power is available at any specified time, e.g diesel generator

3.4
non-dispatchable power system
power system considered non-dispatchable system when it is resource dependent and whose power might not be available at a specified time, e.g solar grid connected system

3.5
storage
storage of energy produced by one of the generators of the system and which can be reconverted through the system into electricity

3.6
rural mini-power plant
power plant that produces less than 100 kVA through the use of a single resource or hybrid system

3.7
rural mini-grid
grid that transfers a capacity level less than 100 kVA and powered by a micro-power plant

3.8
individual electrification system
IES
micro-power plant system that supplies electricity to one consumption point usually with a single energy resource point

3.9
collective electrification system
CES
micro-power plant and micro-grid that supplies electricity to multiple consumption points using a single or multiple energy resource points

3.10
isolated site
electric characteristic to define a specific location not currently connected to a national/ regional grid

3.11
remote site
remote area
geographic characteristic to define a specific location far from developed infrastructures, specifically energy distribution

4 Functional requirements of production and distribution subsystems

4.1 General

The purpose of Clause 4 is to provide a method for describing the results to be achieved by electrification systems for isolated sites as defined in IEC TS 62257-2. It describes the

characteristics expected from these installations based on production of electricity from renewable and/or fossil energy sources.

This stage of defining the expected results of production precedes the technical dimensioning and details engineering stages.

4.2 Overall needs to be satisfied

4.2.1 Main factors to be considered

Figure 1 illustrates the main factors influencing the design of the micro-power plant.

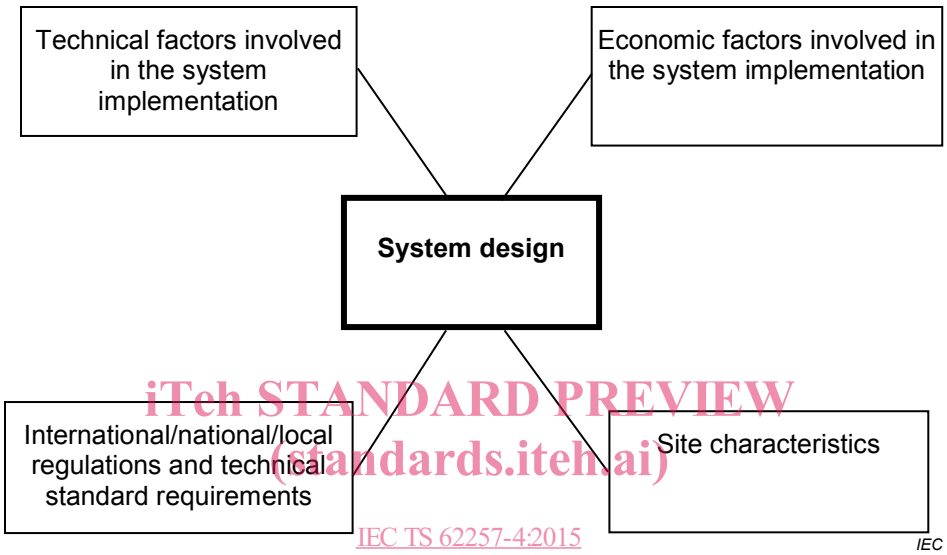

Figure 1 – Factors involved in the design of a system

4.2.2 Needs and characteristics to be considered

For each of the factors depicted in Figure 1, detailed needs or characteristics to be considered shall be identified. These needs and characteristics are defined in Tables 1 to 4.

Table 1 – Technical factors – needs or characteristics to be considered

Nature of participant	Needs or characteristics
Project developer/owner	Compliance with the general specification and relevant standards. Efficient use of energy (demand side management).
Project implementer/subcontractor	Easiest possible implementation: limited constraints in terms of transportation means and lifting apparatus. Technology compatible with limited skills of local manpower. Limited installation work duration on field. Standardized equipment.
Operator	Simple operational rules to cope with possible limited skills of local operating agents. Simple mounting tools. Reliable equipment. Simple management rules. Clear and unambiguous contractual rules not liable to lead to situations of dispute or litigation. Relevant technical choices/customer management. Limited spare parts variety.
Maintenance contractor	Reliable and easy-to replace on site equipment. Limited spare parts variety.
Different users/loads	Types of energy services (see IEC TS 62257-2:2015, Annex B).

Table 2 – Economic factors – needs and characteristics to be considered

Nature of participant	Needs or characteristics
Project developer/owner	Balance between initial capital costs and operational costs to make the project profitable and sustainable.
Project implementer	Balance between equipment cost (purchase and installation) and specified level of reliability.
Subcontractor	To make a correct living while fulfilling the project implementer's requirements.
Operator	Operational costs as low as possible.
Maintenance contractor	To have an economically viable activity while fulfilling the operator's requirements.
The different users/loads	Available services promised (lighting, TV, etc.) at the contractual level of quality, for the agreed price.

Table 3 – Site characteristics

General characteristics of site	Detailed characteristics	Comments
Geographical environment	Weather statistics (T°, humidity, wind, precipitation, etc.)	General information about the standard conditions at the site.
	Climate and severe weather or other local hazards	The characteristics of the climate at the site will affect the design of the system and the nature of its constituent equipment. One may mention: • temperature differences; • hygrometry differences; • rainfall and snowfall; • superimposed loads on structures (caused by wind, cyclones, frost, etc.); • pollution (sand, salt, dust, other pollutant wastes).
	Energy resources	Definition of local energy resources. See Table 4 for further details.
	Means of access to and around the site	General access to the site, bridges road conditions and ease of access around the site (streets, rivers, etc.) will affect the difficulty in crossing obstacles and anticipating changes in the micro distribution network, etc.
	Nature of soil (geological environment)	This affects the type of structure (overhead or buried power lines) to be set up and the execution of certain installations (for example grounding system depending on the resistively characteristics of the ground and system foundations).
	Geographical distribution of the user points	This is a major factor in the cost of the distribution infrastructures. The scatter or concentration of the user points, their probable evolution (near or remote) time-wise and space-wise, will affect choices concerning the topology of the distribution network.
Human environment	Distance to/between homes / loads – production system	
	Type of homes /loads	
	Acceptable noise level	
	Acceptable waste disposal level	
	Type of building to house the rural micro-power plant	
Biological environment	Fauna	
	Flora	
	Type of tree cover	
Technical environment	Type of grid in place, if any (overhead, buried)	
	Civil engineering	
	Quality of existing building	This may be either an ally or an enemy as regards to certain solutions for providing supports for conductors (the physical quality of the building, its height, etc.)
	Possible local maintenance at site	
	Available telecommunication facilities	
	Equipment restrictions	
	Local technical skills level	
	Soil resistivity	