



BSI Standards Publication

Microgrids

Part 1: Guidelines for microgrid projects planning and specification

National foreword

This Published Document is the UK implementation of IEC/TS 62898-1:2017.

The UK participation in its preparation was entrusted to Technical Committee GEL/8, Systems Aspects for Electrical Energy Supply.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2017
Published by BSI Standards Limited 2017

ISBN 978 0 580 89728 3

ICS 29.240.01

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 August 2017.

Amendments/corrigenda issued since publication

| Date | Text affected |
|------|---------------|
|------|---------------|



IEC TS 62898-1

Edition 1.0 2017-05

TECHNICAL SPECIFICATION



**Microgrids –
Part 1: Guidelines for microgrid projects planning and specification**





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
 3, rue de Varembe
 CH-1211 Geneva 20
 Switzerland

Tel.: +41 22 919 02 11
 Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - www.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.



IEC TS 62898-1

Edition 1.0 2017-05

TECHNICAL SPECIFICATION



**Microgrids –
Part 1: Guidelines for microgrid projects planning and specification**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.01

ISBN 978-2-8322-4360-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

| | |
|---|----|
| FOREWORD..... | 5 |
| INTRODUCTION..... | 7 |
| 1 Scope..... | 8 |
| 2 Normative references | 8 |
| 3 Terms and definitions | 8 |
| 4 General principles | 13 |
| 4.1 General..... | 13 |
| 4.2 Preliminary study | 14 |
| 4.3 Overall microgrid planning and design process | 14 |
| 5 Purpose and application of microgrids | 15 |
| 5.1 Application classification | 15 |
| 5.2 Application of non-isolated microgrids | 15 |
| 5.3 Application of isolated microgrids..... | 15 |
| 6 Resource analysis and generation forecast..... | 16 |
| 6.1 Resource analysis..... | 16 |
| 6.1.1 General | 16 |
| 6.1.2 Non-dispatchable resource analysis | 16 |
| 6.1.3 Dispatchable resource analysis | 17 |
| 6.2 Generation forecast | 17 |
| 6.2.1 General | 17 |
| 6.2.2 Technical requirements | 17 |
| 6.2.3 Data processing..... | 18 |
| 7 Load forecast | 18 |
| 7.1 General..... | 18 |
| 7.2 Load analysis..... | 18 |
| 7.3 Classification of load forecast | 19 |
| 7.4 Technical requirement | 19 |
| 8 Distributed energy resource planning..... | 20 |
| 8.1 Ratio of renewable energy | 20 |
| 8.2 Renewable generation configuration | 20 |
| 8.3 Energy storage | 20 |
| 8.4 Electric power and energy balancing | 20 |
| 8.5 Dispatchable generation configuration | 20 |
| 9 Microgrid power system planning..... | 21 |
| 9.1 Voltage level..... | 21 |
| 9.2 Typical topology of a microgrid | 21 |
| 9.2.1 Typical topology for a non-isolated microgrid | 21 |
| 9.2.2 Typical topology for an isolated microgrid | 23 |
| 9.3 Electrical parameter calculations..... | 23 |
| 10 Technical requirements for DER in microgrids | 23 |
| 10.1 General..... | 23 |
| 10.2 Technical requirements for DER in grid-connected mode | 24 |
| 10.3 Technical requirements for DER in isolated microgrids and island mode of non-isolated microgrids | 24 |
| 11 Technical requirements for distribution lines in microgrids | 24 |
| 12 Technical requirements for microgrid connection to distribution networks | 24 |

| | | |
|-----------------------|---|----|
| 12.1 | General..... | 24 |
| 12.2 | Interface protection..... | 24 |
| 12.3 | Microgrid earthing..... | 25 |
| 12.3.1 | General..... | 25 |
| 12.3.2 | Technical requirements for microgrid earthing..... | 25 |
| 12.4 | Power quality at POC..... | 25 |
| 12.4.1 | General..... | 25 |
| 12.4.2 | Power quality monitoring..... | 25 |
| 13 | Technical requirements for control, protection and communication systems..... | 26 |
| 13.1 | Microgrid control..... | 26 |
| 13.1.1 | General..... | 26 |
| 13.1.2 | Control scheme..... | 26 |
| 13.2 | Protection relays and automatic protection devices..... | 26 |
| 13.2.1 | General..... | 26 |
| 13.2.2 | DER component protection..... | 27 |
| 13.2.3 | Component protection for all users in a microgrid..... | 27 |
| 13.2.4 | Load shedding in a microgrid..... | 27 |
| 13.3 | Microgrid communication..... | 27 |
| 13.3.1 | Communication within microgrid subsystem..... | 27 |
| 13.3.2 | Microgrid communication with connected distribution system..... | 27 |
| 13.4 | Information exchange..... | 27 |
| 14 | Evaluation of microgrid projects..... | 28 |
| 14.1 | General..... | 28 |
| 14.2 | Reliability of power supply..... | 28 |
| 14.3 | Economic benefits..... | 28 |
| 14.4 | Environmental benefits..... | 28 |
| 14.5 | Scalability..... | 28 |
| 14.6 | Integration to the wider electric power system..... | 28 |
| Annex A (informative) | Business use case A Guarantee a continuity in load service by islanding with microgrids..... | 29 |
| A.1 | General..... | 29 |
| A.2 | Purpose..... | 29 |
| A.3 | Objectives..... | 29 |
| Annex B (informative) | Business use case B Optimize local resources to provide services to customers inside the microgrid..... | 30 |
| B.1 | General..... | 30 |
| B.2 | Purpose..... | 30 |
| B.3 | Objectives..... | 30 |
| Annex C (informative) | Business use case C Electrify remote areas using renewable energy sources..... | 31 |
| C.1 | General..... | 31 |
| C.2 | Purpose..... | 31 |
| C.3 | Objectives..... | 31 |
| C.4 | Basic functions..... | 31 |
| C.5 | Advanced functions..... | 31 |
| Annex D (informative) | Business use case D Optimize local resources to provide services to the grid/disaster preparedness..... | 32 |
| D.1 | General..... | 32 |
| D.2 | Scope..... | 32 |

| | | |
|-----|--|----|
| D.3 | Objectives..... | 32 |
| D.4 | Basic functions | 32 |
| D.5 | Advanced functions..... | 32 |
| | Bibliography..... | 33 |
| | Figure 1 – Overall microgrid planning and design process | 14 |
| | Figure 2 – Single bus structure microgrid..... | 21 |
| | Figure 3 – Multiple bus structure microgrid | 22 |
| | Figure 4 – Multilevel structure microgrid | 22 |
| | Figure 5 – Typical topology for an isolated microgrid | 23 |

Currently in preview, click buy full version.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MICROGRIDS –

Part 1: Guidelines for microgrid projects planning and specification

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, accept IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- 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 TS 62898, which is a Technical Specification, has been prepared by IEC technical committee 8: Systems aspects for electrical energy supply.

The text of this Technical Specification is based on the following documents:

| | |
|---------------|------------------|
| Enquiry draft | Report on voting |
| 8/1445/DTS | 8/1460/RVDTS |

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

A list of all parts in the IEC 62898 series, published under the general title *Microgrids*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Microgrids can serve different purposes depending on the primary objectives of their applications. They are usually seen as means to manage reliability of supply in a grid contingency and local optimization of energy supply by controlling distributed energy resources (DER). Microgrids also present a way to provide electricity supply in remote areas and to use clean and renewable energy as a systemic approach for rural electrification.

This part of IEC 62898 defines the guidelines for the general planning and design of microgrids, and IEC TS 62898-2¹ defines the general technical requirements for operation and control of microgrids.

This document mainly covers the following issues:

- determination of microgrid purpose and application;
- preliminary study used for microgrid planning, including resource analysis, load forecast, DER planning and microgrid power system planning;
- principles of microgrid technical requirements that should be specified during planning stage;
- microgrid evaluation to select an optimal planning scheme for a microgrid project.

IEC TS 62898-2 mainly covers the following issues:

- operation requirements and control targets of microgrids under different operation modes;
- basic control strategies and methods under different operation modes;
- requirements of energy storage, monitoring and communication under different operation modes;
- power quality.

Microgrids can be stand-alone or be a sub-system of the smart grid. The technical requirements in this document and in IEC TS 62898-2 are intended to be consistent and in line with:

- system requirements from IEC System Committee Smart Energy,
- technical requirements from IEC 62786 for connection of generators intended to be operated in parallel with the microgrid,
- basic rules from IEC TC 64 and TC 99 for safety and quality of power distribution (essentially selectivity, through coordination of protective devices) in installations,
- basic rules from IEC TC 77/SC 77A for electromagnetic compatibility (EMC) issues,
- IEC TS 62257 (all parts) with respect to rural electrification,
- IEC TS 62749 with respect to power quality.

Local laws and regulations can overrule the requirements of this document.

¹ Under preparation. Stage at the time of publication: IEC CD 62898-2:2017.

MICROGRIDS –

Part 1: Guidelines for microgrid projects planning and specification

1 Scope

The purpose of this part of IEC 62898, which is a Technical Specification, is to provide guidelines for microgrid projects planning and specification. Microgrids considered in this document are alternating current (AC) electrical systems with loads and distributed energy resources (DER) at low or medium voltage level. This document does not cover direct current (DC) microgrids.

Microgrids are classified into isolated microgrids and non-isolated microgrids. Isolated microgrids have no electrical connection to a wider electric power system. Non-isolated microgrids can act as controllable units to the electric power system and can operate in the following two modes:

- grid-connected mode;
- island mode.

This document will cover the following areas:

- microgrid application, resource analysis, generation forecast, and load forecast;
- DER planning and microgrid power system planning;
- high level technical requirements for DER in microgrids, for microgrid connection to the distribution system, and for control, protection and communication systems;
- evaluation of microgrid projects.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

IEC 60364 (all parts), *Low voltage electrical installations*

IEC 61936 (all parts), *Power installations exceeding 1 kV AC*

IEC TS 62749, *Assessment of power quality - Characteristics of electricity supplied by public networks*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses: