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# TECHNICAL SPECIFICATION

## Microgrids –
## Part 3-4: Technical requirements – Microgrid monitoring and control systems

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# CONTENTS

FOREWORD ..... 4
INTRODUCTION ..... 6
1 Scope ..... 8
2 Normative references ..... 9
3 Terms, definitions and abbreviated terms ..... 10
3.1 Terms and definitions ..... 10
3.2 Abbreviated terms ..... 12
4 Overview ..... 12
4.1 General ..... 12
4.2 System architecture ..... 13
4.2.1 Stand-alone MMCS ..... 13
4.2.2 Integrated MMCS ..... 14
4.3 Hardware and software architectures ..... 14
4.3.1 Hardware ..... 14
4.3.2 Software ..... 15
4.3.3 Database ..... 15
4.4 Communication and cyber security ..... 15
4.4.1 Communication ..... 15
4.4.2 Cyber security ..... 16
5 Functional requirements ..... 17
5.1 Data acquisition and processing ..... 17
5.1.1 Data acquisition ..... 17
5.1.2 Data processing ..... 17
5.2 Database management ..... 18
5.3 Human-machine interface ..... 18
5.4 Anti-maloperation locking and alarm ..... 19
5.5 Time synchronization ..... 20
5.6 Local power quality control ..... 20
5.7 Frequency/voltage regulation during steady state operation of isolated microgrid ..... 20
5.8 Sequence of operations ..... 21
5.9 Control of device switching ..... 21
5.10 Operating mode transition ..... 21
5.10.1 General ..... 21
5.10.2 Transition from island mode to grid-connected mode ..... 22
5.10.3 Transition from grid-connected mode to island mode ..... 22
5.11 Active and reactive power control ..... 22
5.11.1 General ..... 22
5.11.2 Active power control ..... 22
5.11.3 Reactive power control and voltage control ..... 23
5.12 Islanding detection ..... 23
5.13 Black start ..... 24
Annex A (informative) Example of collected information of MMCS ..... 25
A.1 Microgrid operating data ..... 25
A.1.1 Status data ..... 25
A.1.2 Measurement data ..... 25

A.2 Microgrid equipment operating status data ..... 26
A.2.1 Primary equipment operating status data ..... 26
A.2.2 Secondary equipment operating status data ..... 26
A.2.3 Auxiliary equipment operating status data ..... 26
A.3 Microgrid forecast data ..... 27
A.4 Distributed energy planning data ..... 27
Annex B (informative) Examples of actual microgrid applications and the associated functions of MMCS ..... 28
B.1 Application CN1: MMCS of microgrid with photovoltaic and battery compacted with monitoring and control system of intelligent office park ..... 28
B.1.1 General ..... 28
B.1.2 System structure of MMCS ..... 29
B.1.3 Main functions of MMCS ..... 29
B.1.4 Applications ..... 30
B.2 Application CN2: MMCS of MV small hydropower microgrid for solving power supply problems in remote areas ..... 30
B.2.1 General ..... 30
B.2.2 System structure of MMCS ..... 31
B.2.3 Main functions of MMCS ..... 32
B.2.4 Applications ..... 34
B.3 Application JP1: Power stabilization with combining high-speed $\Delta F$ and $\Delta P$ suppression control utilizing storage batteries connected to thermal generation: the IKI island demonstration project from Japan ..... 36
B.3.1 General ..... 36
B.3.2 Purpose ..... 37
B.3.3 Main functions of MMCS ..... 37
B.3.4 Applications ..... 38
Bibliography ..... 40

Figure 1 – Functional mapping for operation and control of microgrids ..... 13
Figure 2 – Structure of MMCS ..... 14
Figure 3 – Typical three-layer communication for structure 1 ..... 16
Figure 4 – Typical two-layer communication for structure 2 ..... 16
Figure B.1 – Primary structure of Chengchuang microgrid ..... 28
Figure B.2 – System structure of MMCS ..... 29
Figure B.3 – The main single line diagram of the small hydropower microgrid ..... 31
Figure B.4 – The main structure of MMCS ..... 32
Figure B.5 – Daily voltage curve along the common line and Fengshan line before the implementation of microgrid in flooding period and heavy load ..... 34
Figure B.6 – Daily voltage curve along the common line and Fengshan line after the implementation of microgrid ..... 35
Figure B.7 – Daily voltage curve along the common line and Fengshan line before the implementation of microgrid ..... 35
Figure B.8 – Daily voltage curve along the common line and Fengshan line after the implementation of microgrid ..... 36
Figure B.9 – Overview of Iki Island power system and battery ..... 37
Figure B.10 – Overview of control flow ..... 38
Figure B.11 – Example of stable frequency due to storage battery charge / discharge ..... 39

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# MICROGRIDS

## Part 3-4: Technical requirements – Microgrid monitoring and control systems

## FOREWORD

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IEC TS 62898-3-4 has been prepared by subcommittee 8B: Decentralized electrical energy systems, of IEC technical committee TC 8: System aspects of electrical energy supply. It is a Technical Specification.

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

| Draft | Report on voting |
|---|---|
| 8B/154/DTS | 8B/178/RVDTS |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 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.

# 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 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.

At present, there are many types of microgrid, often composed of distributed generation, battery energy storage, load, and other equipment. To achieve the effective integration and cooperative operation of the above equipment, a set of computer systems is often required, which is normally named as microgrid monitoring and control system. With the popularization of microgrids, the industry urgently needs a standard to specify the system architecture, component composition and functional requirements of microgrid monitoring and control system.

There are also various types of microgrid monitoring and control systems. For large scale (installed power > 100 kW) microgrid, its monitoring system and control system is more complex, usually using independent servers, workstations, remote terminal units, and others. Its communication protocol and data model can be based on the IEC 61850 series, and the system consists of a master station level and a local equipment level. For small-scale microgrids below 100 kW level, such as household microgrids with photovoltaic power generation and battery storage, it is relatively expensive to configure a complex microgrid monitoring and control system. At this time, the microgrid will generally adopt lightweight and cheap technical solutions, and the microgrid monitoring, control and energy management function will often be combined into a single device. Sometimes, for the small microgrid in remote mountainous areas, microgrid monitoring and control system based on the Internet of Things and cloud computing architecture is often used to realize the local autonomy and remote monitoring of the micro grid.

IEC TS 62898 series is intended to provide general guidelines and technical requirements for microgrid projects.

IEC TS 62898-1 mainly covers the following issues:

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

IEC TS 62898-2 mainly covers the following issues:

- operation requirements and control targets of microgrids under various operation modes,
- the basic control strategies and methods under various operation modes,
- the requirements of electrical energy storage (EES), relay protection, monitoring and communication under various operation modes,
- power quality.

IEC TS 62898-3-XX subseries technical specifications deal with the technical requirements of microgrids.

IEC TS 62898-3-1 mainly covers the following issues:

- requirements for microgrid protection,
- protection systems for microgrids,
- dynamic control for transient and dynamic disturbances in microgrids.

IEC TS 62898-3-2[1] covers the energy management system of microgrids.

IEC TS 62898-3-3 covers the self-regulation of dispatchable loads of microgrids.

This document covers microgrid monitoring and control systems (MMCS). It aims to provide requirements to address state monitoring and operation control problems in microgrids.

[1] Under preparation.

# MICROGRIDS

## Part 3-4: Technical requirements – Microgrid monitoring and control systems

## 1 Scope

The purpose of this part of IEC 62898 is to provide technical requirements for the monitoring and control of microgrids. This document applies to non-isolated or isolated microgrids integrated with distributed energy resources. This document describes the specific recommendations for low-voltage (LV) and medium-voltage (MV) microgrids.

This document focuses on standardization of the architecture, functions, and operation of microgrid monitoring and control systems (MMCS). It teases out the general functions of MMCS and provides technical requirements for MMCS. This document includes the following aspects of MMCS:

- system architecture,
- information exchange with other devices/functions in microgrid,
- performance requirement,
- main function descriptions.

The system architecture for MMCS:

- For a large scale (installed power > 100 kW) microgrid, microgrid energy management system (MEMS) and MMCS are normally separated. MMCS normally contains data servers, application servers, workstations, routers, information safety devices, SCADA, communication system, distributed generation controller, microgrid central controller, load controller, grid connection interface device and other ancillary equipment.
- For a small user-side microgrid (normally less than 100 kW), MEMS and MMCS are normally merged into one embedded device with system on chip, which is named as microgrid controller.

Main functions of MMCS:

- Data acquisition and processing, including collecting real-time data from the distributed generation, load, switches, transformers and reactive power compensation devices, and calculation and analysis of the acquired data.
- Database management, including maintaining, synchronizing, backing up, restoring the acquired data, and providing the data interface with other internal and external applications.
- Human-machine interface, including the real-time monitor screen and interface which is capable of remote control, mode switching, manual data entry, etc.
- Anti-maloperation locking and alarm, to lock the maloperation based on the predefined rule and logic.
- Time synchronization, including receiving the time synchronization signal from Global Navigation Satellite System (GNSS) or network time protocol (NTP) and synchronizing the time of each device within the microgrid.
- Local power quality evaluation and control the ability to collect information of out-of-limit voltage, power factor, harmonic, etc. and carry out control to improve power quality accordingly.
- Frequency/voltage regulation during steady state operation of an isolated microgrid to provide voltage and frequency inside an accepted operation range.

- Sequence of operations, or steady transition from power-off to start-up and from start-up to power-off.
- Switch control of devices within microgrids, including turning on and off loads, generation units, transformers, reactive power compensation devices, etc.
- Islanding detection, including real-time detection on power outage of the upstream distribution system.
- Operation mode transition, including transition from grid-connected mode to island mode and transition from island mode to grid-connected mode.
- Active and reactive power control, including load shedding (if required), load sharing and controlling the active and reactive power in real time according to the MEMS or manual command.
- Black start, the ability to initiate power sources and loads to ensure the microgrid can initiate operation from a non-energized state.
- Interface with the protection system or earthing system when adaptations are required according to the microgrid operating modes.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all 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 60870-5-101, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-104, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC 62443 (all parts), *Security for industrial automation and control systems*

IEC 62586-1, *Power quality measurement in power supply systems – Part 1: Power quality instruments (PQI)*

IEC TS 62898-1, *Microgrids – Part 1: Guidelines for microgrid projects planning and specification*

IEC TS 62898-2, *Microgrids – Part 2: Guidelines for operation*

IEC TS 62898-3-1, *Microgrids – Part 3-1: Technical requirements – Protection and dynamic control*

IEC TS 62898-3-2:—[2], *Microgrids – Part 3-2: Technical requirements – Energy management systems*

IEC TS 62898-3-3, *Microgrids − Part 3-3: Technical requirements − Self-regulation of dispatchable loads*

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[2] Under preparation. Stage at the time of preparation: IEC DTS 62898-3-2:2023.

IEEE Std 1815-2012, *IEEE Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)*

IRIG-B Standards Documentation (IRIG.ORG) [viewed 2023-08-07]

Modbus Standards Documentation (Modbus.org) [viewed 2023-08-07]

NTP Standards Documentation (ntp.org) [viewed 2023-08-07]

OASIS Standards Documentation, MQTT Version 5.0 (oasis-open.org) [viewed 2023-07-24]