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TECHNICAL SPECIFICATION

colour inside

High voltage direct current (HVDC) grid systems and connected converter stations – Guideline and parameter lists for functional specifications – Part 1: Guideline



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High voltage direct current (HVDC) grid systems and connected converter stations – Guideline and parameter lists for functional specifications – Part 1: Guideline

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HIGH VOLTAGE DIRECT CURRENT (HVDC) GRID SYSTEMS AND CONNECTED CONVERTER STATIONS – GUIDELINE AND PARAMETER LISTS FOR FUNCTIONAL SPECIFICATIONS –

Part 1: Guideline

FOREWORD

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IEC TS 63291-1 has been prepared by IEC technical committee TC 115: High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV. It is a Technical Specification.

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

Draft	Report on voting
115/319/DTS	115/328A/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 Technical Specification is to be used in conjunction with IEC TS 63291-2:2023.

A list of all parts in the IEC 63291 series, published under the general title *High voltage direct current (HVDC) grid systems and connected converter stations – Guideline and parameter lists for functional specifications*, can be found on the IEC website.

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/standardsdev/publications.

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INTRODUCTION

In the preparation of this document, special care has been taken to, as far as possible, describe the requirements in a technologically independent way. In order to achieve that, a function of interest is described by a comprehensive set of parameters. The parameters are selected based on a systematic analysis of physical phenomena relevant to achieve the requested functionality.

Reflecting the early stage of technology, the technical parameters need comprehensive explanations and background information. This need is reflected in the dual character of the content, which is presented in the two corresponding parts:

- IEC TS 63291-1, Guideline containing the explanations and the background information in context with the parameter lists;
- IEC TS 63291-2, Parameter lists containing the essential lists of parameters and values describing properties of the AC respectively DC system (operating conditions) and parameters describing the performance of the newly installed component (performance requirements).

IEC TS 63291-1 and IEC TS 63291-2 have the same structure to aid the reader.

At the time of writing there is no real-life multi-national, multi-vendor HVDC grid project to which the guideline and parameter lists can be applied. Practical experiences in the near future are expected to provide input for developing these guideline and parameter lists further.

HIGH VOLTAGE DIRECT CURRENT (HVDC) GRID SYSTEMS AND CONNECTED CONVERTER STATIONS – GUIDELINE AND PARAMETER LISTS FOR FUNCTIONAL SPECIFICATIONS –

Part 1: Guideline

1 Scope

This document contains guidelines on planning, specification, and execution of multi-vendor HVDC grid systems also referred to as HVDC grids. The terms "HVDC grid systems" or "HVDC grids" are used in this document to describe HVDC systems for power transmission having more than two HVDC stations connected to a common DC circuit. The DC circuit can be of radial or meshed topology or a combination thereof. In this document, the term "HVDC grids" is used.

While this document focuses on requirements specific for HVDC grids, some requirements are considered applicable to all HVDC systems in general, i.e., including point-to-point HVDC systems. Existing IEC (e.g. IEC TR 63363-1 [1]), Cigre or other relevant documents have been used for reference as far as possible.

Corresponding to electric power transmission applications, this document is applicable to high voltage systems, i.e. those having typically nominal DC voltages higher than 50 kV with respect to earth are considered in this document.

NOTE While the physical principles of DC networks are basically voltage independent, the technical options for designing equipment get much wider with lower DC voltage levels, e.g. in case of converters or switchgear.

This document covers technical aspects of:

- coordination of HVDC grid and AC systems,
- HVDC grid characteristics,
- HVDC grid control,
- HVDC grid protection,
- AC/DC converter stations,
- HVDC grid installations, including DC switching stations and HVDC transmission lines,
- studies and associated models,
- testing.

Beyond the scope of this document, the following content is proposed for future work:

- DC/DC converter stations.

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 60909 (all parts), *Short-circuit currents in three-phase AC systems*

IEC 61975:2010, *High-voltage direct current (HVDC) installations – System tests*
IEC 61975:2010/AMD1:2016
IEC 61975:2010/AMD2:2022

IEC 62271-100, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

IEC 62271-102, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62747:2014, *Terminology for voltage-sourced converters (VSC) for high-voltage direct current (HVDC) systems*
IEC 62747:2014/AMD1:2019

IEC TS 63014-1, *High voltage direct current (HVDC) power transmission – System requirements for DC-side equipment – Part 1: Using line-commutated converters*

IEC TS 63291-2:2023, *High voltage direct current (HVDC) grid systems and connected converter stations – Guideline and parameter lists for functional specifications – Part 2: Parameter lists*

ISO/IEC 25010:2011, *Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models*

3 Terms, definitions and abbreviated terms

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

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Terms and definitions

3.1.1
AC/DC converter unit
indivisible operative unit comprising all equipment between the PoC-AC and the PoC-DC, essentially one or more converters, together with interface transformers, control and protection equipment, essential protective and switching devices and auxiliaries, if any, used for conversion

Note 1 to entry: The term "converter transformer" is also used instead of "interface transformer".

[SOURCE: IEC 62747:2014, 7.5, modified – "AC/DC" has been added to the term; the definition has been neutralised with respect to technology (not only VSC converters) and uses the terms PoC-AC and PoC-DC as defined in 3.1.3 and 3.1.4 in this document.]

3.1.2
AC/DC converter station
part of an HVDC system which consists of one or more AC/DC converter units including DC switchgear, if any, DC fault current controlling devices, if any, installed in a single location together with buildings, reactors, filters, reactive power supply, control, monitoring, protective, measuring and auxiliary equipment

[SOURCE: IEC 62747:2014, 9.21, modified – "AC/DC" has been added to the term; the definition has been made specific with respect to AC/DC converter units, differentiating from