



TECHNICAL SPECIFICATION

**Joint commissioning for grid-connection of offshore wind farms using VSC
HVDC transmission**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Joint commissioning for grid-connection of offshore wind farms using VSC HVDC transmission

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

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| Draft | Report on voting |
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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.

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- withdrawn, or
- revised.

INTRODUCTION

This document addresses the joint commissioning of grid-connection of offshore wind farms (GCOWF) using the voltage source converter based high voltage direct current (VSC HVDC) transmission system. The test purpose, test preconditions, test procedures and methods, and test acceptance criteria for joint commissioning are introduced in this document. The scope of the document covers the commissioning of offshore wind farms, testing of the onshore DC energy dissipation device, special test items for transmission test, coordination function testing among the VSC HVDC system, DC energy dissipation device, offshore wind farm and automatic generation control (AGC). The conventional commissioning test items of the VSC HVDC system are out of scope.

Due to the advantages of abundant and highly qualified wind resources, offshore wind farms have become the development trend of wind power generation. Currently, the VSC HVDC power transmission technology provides a solution for grid connection of the large-scale and long-distance offshore wind power farms since it can achieve power supply for a passive system, long-distance power transmission, and flexible and independent control for active and reactive power. In this context, a number of large-scale and long-distance wind power farms, connected with power grid using VSC HVDC power transmission, have been put into commercial operation around the world, such as China, Germany, and the UK.

More and more offshore wind farms will be integrated into the onshore AC power grid using VSC HVDC power transmission. The commissioning is the final on-site test for grid-connection of offshore wind farms using VSC HVDC power transmission, to help ensure that the whole system can safely and reliably operate, and meet the grid connection requirements, as well as the relevant contracts and specifications.

Compared with the commissioning of conventional VSC HVDC projects, the joint commissioning procedures, methods, and grid-connection requirements of the VSC HVDC projects with integration of offshore wind farms are different, due to the special offshore operating conditions, as well as the existence of onshore DC energy dissipation device and the offshore wind farms. Therefore, it is important to draft a technical specification on joint commissioning for grid-connection of offshore wind farms using VSC HVDC power transmission.

The purpose of this document is to elaborate on the commissioning procedures, test items, conditions, methods, and special requirements of grid-connection of offshore wind farms to help ensure the integrity and correctness of the commissioning. It is possible that the document is not applicable to all projects but represents a range of possible system tests which should be considered. The commissioning requirements and procedures provided in this document are not for any specific project and these should be considered according to the agreement between the purchaser and supplier and as applicable.

1 Scope

This document serves as a specification for the joint commissioning of grid-connection of offshore wind farms (GCOWF) using the voltage source converter based high voltage direct current (VSC HVDC) transmission system.

This document provides the technical specification on the commissioning precondition, objectives, procedures, items, methods and requirements of grid-connection of offshore wind farms using the VSC HVDC power transmission, particularly focusing on the special test items of offshore wind farms.

This document covers the commissioning of offshore wind farms, testing of onshore DC energy dissipation device, special test items for transmission test, coordination function testing among VSC HVDC, DC energy dissipation device, offshore wind farm and automatic generation control (AGC). However, the conventional commissioning test items of the onshore VSC HVDC system are out of scope.

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 60050-811, *International Electrotechnical Vocabulary - Part 811: Electric traction*, www.electropedia.org

IEC 60270, *High-voltage test techniques - Charge-base measurement of partial discharges*

IEC 60633:2019, *High-voltage direct current (HVDC) transmission - Vocabulary*

IEC 61400-3-1, *Wind energy generation systems - Part 3-1: Design requirements for fixed offshore wind turbines*

IEC 61400-3-2, *Wind energy generation systems - Part 3-2: Design requirements for floating offshore wind turbines*

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

IEC 62934, *Grid integration of renewable energy generation - Terms and definitions*

IEC TS 63336:2024, *Commissioning of VSC HVDC systems*

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IEC 60050-415, *International Electrotechnical Vocabulary - Part 415: Wind turbine generator systems, available at www.electropedia.org*

IEC 60228, *Conductors of insulated cables*

IEC 61000-4-30, *Electromagnetic compatibility (EMC) - Part 4-30: Testing and measurement techniques - Power quality measurement methods*

IEC 61400-25-3, *Wind turbines - Part 25-3: Communications for monitoring and control of wind power plants - Information exchange models*

IEC 61400-21-2, *Wind energy generation systems - Part 21-2: Measurement and assessment of electrical characteristics - Wind power plants*

IEC 62501:2024, *Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission - Electrical testing*
